January 1945

Surveying and Mapping

Featuring:

Second Consultation on Geography and Cartography
R. H. RANDALL

Cartography in Brazil
DR. LEITE DE CASTRO

Land Surveying
R. GETTY BROWNING

Control Surveys and Beyond
CARROLL F. MERRIAM

Surveys and Maps in State Planning
ELISABETH M. HERLIHY

Surveying and Mapping in the Americas
COL. GERALD FITZGERALD

Property Line Surveys and Land Titles
E. H. OWENS

A Combination of Surveying Methods Is Best
PAUL VAN BUSKIRK

Quarterly Journal
AMERICAN CONGRESS ON SURVEYING AND MAPPING
Box 470, Benjamin Franklin Station, Washington 4, D. C.

OFFICERS OF THE CONGRESS

President

GEORGE D. WHITMORE
Tennessee Valley Authority
710 Pound Bldg., Chattanooga, Tenn.

Treasurer and Acting Executive Secretary

MAJOR RICHARD T. EVANS
U. S. Geological Survey
Washington, D. C.

Regional Vice Presidents

Region 1
PROF. DOUGLAS S. TROWBRIDGE
New York University
New York, N. Y.

Region 2
MARSHALL S. WRIGHT
2613 S. Kent Street
Arlington, Va.

Region 3
PROF. RALPH P. BLACK
Georgia School of Technology
Atlanta, Georgia

Region 4
PROF. W. H. RAYNER
University of Illinois
Urbana, Ill.

Region 5
RALPH J. MCMAHON
Magnolia Petroleum Co.
Dallas, Texas

Region 6
PROF. E. W. CARLTON
Missouri School of Mines
Rolla, Missouri

Region 7
WINFRED L. PROUTY
320 Ivy Street
Denver 7, Colo.

Region 8
HOWARD R. SAUNDERS
4210 Cedros Avenue
Sherman Oaks, Calif.

Region 9
LEWIS A. MCARTHUR
Pacific Power & Light Co.
Public Service Bldg., Portland, Ore.

Region 10
HAROLD F. FOLEY
U. S. Engineer Office
Edmonton, Alberta, Canada

EDITOR

A. L. SHALOWITZ
U. S. Coast & Geodetic Survey
Washington, D. C.

SURVEYING and MAPPING

Journal of the American Congress on Surveying and Mapping

Volume V • JANUARY 1945 • Number 1

Contents

SECOND PAN AMERICAN CONSULATION ON GEOGRAPHY AND CARTOGRAPHY 2
R. H. Randall

CARTOGRAPHY IN BRAZIL 8
Dr. Leite de Castro

LAND SURVEYING 14
R. Getty Browning

CONTROL SURVEYS AND BEYOND 20
Carroll F. Merriam

SURVEYING AND MAPPING IN THE AMERICAS 26
Colonel Gerald FitzGerald

CURVATURE AND REFRACTION TABLES FOR TOPOGRAPHIC SURVEYS 30
Captain N. B. Favell

OFFICE OF INDIAN AFFAIRS 32

A COMBINATION OF SURVEYING METHODS IS BEST 34
Paul Van Buskirk

SURVEYS AND MAPS IN STATE PLANNING 38
Elisabeth M. Herlihy

PRECISION ALTIMETRY 45
Prof. Philip Kissam

PROPERTY SURVEYS DIVISION 50

Property Line Surveys and Land Titles 53
E. H. Owens

COMMENT AND DISCUSSION 55

SURVEYING AND MAPPING NEWS 59

CONGRESS NEWS 68

MEMBERSHIP APPLICATION 72

SURVEYING AND MAPPING is published quarterly by the AMERICAN CONGRESS ON SURVEYING AND MAPPING, Box 470, Benjamin Franklin Station, Washington 4, D. C. SUBSCRIPTIONS: $3.00 a year to non-members; single copies, $1.00.

Entered as second-class matter at the Post Office at Washington, D. C., November 13, 1944, under the Act of March 3, 1879. Additional entry as second-class matter at the Post Office at Lancaster, Pa.

Second Pan American Consultation on Geography and Cartography

By ROBERT H. RANDALL*

IT IS obvious to the most casual observer that there has been in recent years a tremendous expansion of interest in mapping. Such an interest, of course, is to be expected in wartime. Wars always demand the best possible map information, and during wartime a considerable number of people who have not previously been much concerned with maps in their daily activities become accustomed to reading maps and to depending upon them. Our present awareness of maps, however, comes about not only because of wartime necessities—two other factors are clearly discernible.

One of these factors is the manifest need for maps as the basis for planning and carrying out large improvement projects. Big projects do require a basis of map information, and this is being increasingly recognized. Certainly this has been the case in the United States. Try to imagine the Tennessee Valley Authority—to mention what is perhaps our largest organized program of improvement—building its dams, powerhouses, roads, and other physical structures, and planning for the best use of its agricultural and other lands, without maps. One of the first things the Authority did after its creation was to enter upon a mapping program.

But another principal factor has also been working toward increase in map production and availability. This is, of course, the airplane and the air camera. It is perhaps not too much to say that the airplane and the modern camera have brought about a second age of discovery, comparable in importance and in its implications to the great age of continental discovery typified by Columbus and the early navigators. It would be more exact, perhaps, to say that this new age is one of exploration rather than discovery. For whereas Columbus and his contemporaries discovered continents and islands, and traversed their boundaries, the airplane and camera now make it possible to explore and to record in map form not only the fringes but the interiors of all lands.

Aerial photographs bring to us not only geographic information of the kind that is customarily shown on topographic maps, but they also can be and are being increasingly employed to obtain additional information on such matters as natural vegetative cover, character of soils, and

* Chief Examiner, Surveying and Mapping, United States Bureau of the Budget; United States Member and Chairman, Commission on Cartography, Pan American Institute of Geography and History.

geologic structure. Just by flying over a jungle area, for instance, it is possible to prepare maps which will be better in many respects than any land survey map is likely to be, and in addition to have a competent knowledge of the types of timber in the forest cover, the kind of soils which sustain them, and a surprising amount of insight into the geologic structure of the area.

Present wide interest in maps and the constantly increasing activity in map production, while greatly in evidence in the United States, are by no means confined to it. For both war and peace considerations, all the other American nations are vitally concerned. Since the very same factor of air transportation that has made map making easier has also brought the nations together into easier contact and closer relationship, it has become obvious that the whole question of securing and maintaining adequate map information in any country is of interest not only to that country but to its neighbors in the hemisphere. The question arises then as to the best practicable methods for collaborative action by the American nations to help themselves and each other to attain and maintain the best possible basis of map information.

Pan American Institute of Geography and History

The Pan American Institute of Geography and History, organized in 1929 along the same general lines as the Pan American Union, is the obvious agency to encourage and sustain the drive toward better map progress in the Americas. Not only does such a problem fall within the main objectives for which the Institute was created, but resolutions at its assembly meetings have for years pointed out the necessity for organized collective action of this sort. Consequently, when in the spring of 1941 the United States delegation to the meeting of the Institute held in Lima, Peru, suggested the formation of a Commission on Cartography, the Insitute's Director, Dr. Pedro C. Sanchez, himself sponsored the resolution, and the Commission was established. Since that time the Commission has been active. It has made a fact-finding survey of the status of surveying and mapping in the American nations, and, through the visits of its secretary and through two international meetings, which it has sponsored, it has materially stimulated mapping interest and mapping performance.

The First Consultation on Cartography was held in Washington, D. C., September 29 to October 14, 1943. The American Geographical Society of New York acted as official host, and invitations were extended by the Society and by the Institute to the countries of North and South America. This Consultation was reported in the January 1944 Bulletin of the American Congress on Surveying and Mapping.

The Second Consultation

The Second Consultation, called the "Second Pan American Consultation on Geography and Cartography"—because of the important connection between these two fields and the prominence which geography plays in the thinking of Latin American nations—was held in Rio de Janeiro, Brazil, August 14 to September 2, 1944. The Brazilian National Council on Geography acted as host for the Brazilian Government. Representatives attended from all the nations in the American Hemisphere, with the exception of Haiti, Honduras, and Nicaragua.

The sessions of this Second Consultation were of two sorts: the business and formal sessions, and the technical sessions. The technical sessions were conducted as open meetings of the Commission on Cartography. They were attended by members of the Commission from the various nations in which they have so far been appointed, by the members of the national delegations, and by technical observers from Brazil and the other nations.

The technical discussions were organized around five discussion topics, and two half-day sessions were devoted to each. These were:

Geodesy and Astronomy
Aeronautical charts
Topography and Aerophotogrammetry
Hydrography
Cartography and Geography

Discussion leaders for each topic were selected from the members of the Brazilian Delegation, and the writer, as Chairman of the Commission on Cartography, acted as general chairman in order to co-ordinate the discussion in the several fields. The sessions were conducted in Portuguese, Spanish, and English, but it was usually not necessary to translate as between Portuguese and Spanish.

In general, the time from August 14 to August 26 was spent in Rio. All of the sessions were held in the historic Siligeo Building, the seat of the Brazilian Institute of Geography and History, a national professional society. The business sessions and technical discussion sessions were interspersed with visits to officials of the Brazilian Government and to the Government's geographic and cartographic agencies. The delegates also were entertained at Petropolis, the old summer capitol of the Brazilian Empire near Rio, on August 26 and 27. From August 28 to September 2, they were taken on a very interesting trip which included visits to Volta Redonda, the new steel city; São Paulo, and the seaport city of Santos; and Campinas and Rio Claro in the industrial and agricultural districts of São Paulo; and to fazendas, typically Brazilian farm institu-

tions producing coffee and other agricultural products. The trip included inspection of airports, modern factories, and railroad shops. The delegates who were able to make this trip were given a tremendously interesting insight into Brazilian development, past and present.

Summary of Resolutions

At the First Consultation in Washington, recommendations were made that the Commission on Cartography appoint permanent committees in the fields of geodesy, aeronautical charts, and topographic maps. The resolutions of the Second Consultation are too long to repeat here in full. It should be stated, however, that they reaffirm the necessity for establishing these committees, and recommend that the Commission also create similar committees to deal with hydrography, and cartography and geography. This latter committee was considered necessary to deal with the relationship of cartography to geographic progress, and in particular the service which surveying and mapping, under the general term of cartography, can and should render to geographic science.

Some resolutions of the Consultation should be mentioned. One of these, Resolution No. 24, recommends that all of the American Governments contribute funds to the support of the work of the Commission on Cartography. Another resolution recognized and applauded the work of the United States for the establishment of the aeronautical charts of America, and recommended to the governments of the various countries that they continue to co-operate in this work through their technical organizations. A third important resolution recommended co-operation with the Inter-American Statistical Institute in the establishment of minimum standards for maps to be used for census purposes.

The Consultation also suggested that the Pan American Institute of Geography and History create a Commission on Applied Geography to be concerned with general stimulation and guidance of studies and activities in that field.

Geodesy.—In respect to geodesy, the need of expanding the geodetic triangulation in each country was stressed, and it was recommended that these be tied in at national borders through the good offices of the Institute. The symbols and specifications for accuracy recommended by the International Union of Geodesy and Geophysics, at its general assembly in Washington in 1939, were recommended. The general adoption of the International Ellipsoid of Reference, as recommended at the general assembly of the Union in Madrid in 1924, was urged. The importance of gravity observations was indicated, and it was recommended that the Institute collaborate in the selection and establishment of basic gravity stations. Magnetic and seismologic studies were stated to be of great importance, and it was recommended that agencies for carrying on these

studies be established in all countries and the data resulting be concentrated in the Institute to be co-ordinated and published for use by all.

Other recommendations on geodesy dealt with the installation of tide gages and with the expansion and improvement of leveling operations based upon these. It was also urged that all of the nations represented enact legislation designed to preserve monuments established in connection with triangulation, leveling, and other survey operations.

Topographic Maps and Aerophotogrammetry.—The resolutions urged that the use of aerophotogrammetric methods in topographic surveying be intensified. Another recommendation was that such methods be used to procure reconnaissance maps in areas where such information was needed so that these might be available until such times as more precise topographic maps could be prepared. There was a strong feeling that all cartographic material in this field be interchanged among the various nations. Facilities for educating and training specialized personnel in the various techniques in this field were recommended. Another recommendation suggested that the type of projection be noted on all maps.

Aeronautical Charts.—Aeronautical charts were of universal interest. The Consultation heartily approved the work of the United States in establishing aeronautical charts of America, and urged continued cooperation on the part of the various countries in this. It was recommended that the preparation of such charts be intensified and expanded, and that aeronautical chart information should be interchanged.

Resolution 15 recommended that the scale 1 : 1,000,000 in the sheet size of 22 by 29 inches (55 by 72 cms.) be adopted as the standard aeronautical chart, and that the Commission's Committee on Aeronautical Charts be instructed to prepare specifications for this standard chart and to work toward further standardization.

For the greater safety of air navigation it was recommended that "Notice to Airmen" be published periodically and that corrections should regularly be made on air navigation charts.

Hydrographic Charts.—Hydrographic charts, while not specifically included in the field of discussion in the First Consultation, were the subject of much interest in this Second Consultation. In addition to the recommendation that the Commission establish a committee, specific recommendations were made on several points. For example, it was stressed that all information essential to the safety of maritime navigation, such as depths, navigation hazards, and Notices to Mariners, be classified as public, and speedily disseminated. Only information respecting naval and military installations should be classed as confidential.

In making hydrographic surveys the increased use of aerophotogrammetry was advised, and it was stated that vertical coverage of the shore-

line, as well as coverage of danger zones offshore, be secured wherever practicable. In recognition of the increased accuracy which modern methods of hydrographic surveying make possible, it was recommended that such surveys be extended to greater distances from the shore, even to the extent of going beyond the continental platform.

Conclusions

The Commission on Cartography held two meetings during the Consultation. At the second of these, held on August 30 in São Paulo, the Commission took action on the resolutions which the Consultation had proposed to it, and these actions were reported to the Consultation in a farewell session held on September 1.

It is expected that the active work of the committees, which the Commission is now appointing, will greatly expedite the work of the next Consultation. In the first two Consultations it was necessary for the various nations to report on their accomplishments in surveying and mapping, and upon their plans for the future. In the next Consultation, it is expected that the various committees will have prepared reports showing factual information of this sort in organized form, and that the discussion sessions will be able to devote a larger measure of attention to interchange of ideas and information on such matters as technical procedures and equipment, plans for collaborative action between neighboring nations, education and training, and scientific management.

The Second Consultation, like the first, resulted in much direct and indirect benefit. Better understanding and improved relationships in the important field of basic surveying and mapping were reached. Information on technical processes and recently developed procedures and equipment was interchanged. Ideas on organization and management of national mapping affairs were gained. Personal acquaintances were formed by those who, officially or professionally, are in a large part responsible for cartographic progress in the various nations of the Americas. In many instances these developed into the formulation of specific plans for international collaboration.

* * *

"Cartography is alive with beauties—beauties of art that appeal to the eye and to the taste, beauties of science and human endeavour with which the whole structure is adorned and illustrated."

—Sir H. G. Fordham.

Cartography in Brazil*

By DR. LEITE DE CASTRO
Secretary General, National Council of Geography

I AM truly grateful to the Committee on Arrangements for inviting me to take part in this interesting and constructive meeting. Here I feel very much at home among people of the United States and of Canada because we have the same kind of interests—the fascinating subjects of cartography and geography. I salute all of you very cordially, and I express to all of you my deep thanks for your hospitality.

These thanks which I extend now are not formal, but are natural and sincere, because I am not a diplomat but rather a technician who has convictions and principles and wishes to present them.

At this happy moment some solid and basic convictions move me, as, for example, the belief that (1) only human co-operation and understanding can bring to the world the right and definite directions; (2) science and technique are great factors for the formation of this international understanding, because they prepare the basic physical structure for political structure; (3) geography is the most valuable of these techniques—the technique of actualities—because it gives knowledge of the earth and its peoples for the better understanding and unity of nations; (4) the countries of the Americas are destined to give to the world a moving and constructive example of understanding and brotherhood between peoples; (5) Pan Americanism must be developed more and more on principles which are scientifically precise and politically solid.

To achieve these ends, the development of cartographic techniques is imperative in the countries of the Americas. Thus, I speak to you with a high Pan American spirit, believing that the assembling of geographers and surveyors is also a great power for the unity of the American peoples.

The Second Consultation on Cartography

It is natural that I speak to you first about the Second Pan American Consultation on Geography and Cartography, because it is going to be held in Rio de Janeiro. The Consultation is promoted by the Commission on Cartography of the Instituto Panamericano de Geografía e Historia and is sponsored and organized by the Conselho Nacional de Geografía of Brazil, of which I am Executive Director and General Secretary. The chairman of the Commission on Cartography of the Institute is the same Ing. Robert Randall who was your first president. The Brazilian Government already has issued, through diplomatic channels, an official

* Presented at Annual Meeting, Washington, D. C., June 3, 1944.

invitation to all of the American republics and to Canada, asking each to send a delegation of technicians to the Rio de Janeiro meeting.

As the General Secretary of the organizing committee of the Second Consultation, I recently visited Bolivia, Peru, Ecuador, Panama, Costa Rica, Guatemala, and Mexico before arriving here; and in these countries I explained the aims of the Second Consultation and its program and urged the respective authorities of those nations to send their best technicians—to send those in charge of surveying and mapping operations in their countries.

Today I am here in this great country of yours, believing that the United States—which organized and was the site of the First Consultation on Cartography—will collaborate efficiently, as is its tradition, in the Second Consultation. I invite you also to send us a delegation of technicians who will present at the meeting contributions of real scientific value.

* * * * *[1]

The Second Consultation on Geography and Cartography is of great importance. It is, furthermore, very timely because we are going to deal objectively with subjects of vital significance to the development of surveying and mapping activities in the Americas. The program of the meeting gives high priority to the subject of geography in postwar problems. I should like to call this to your attention, because this Fourth Annual Congress on Surveying and Mapping is dealing mostly with the previews of planning for postwar operations.

Brazil and Postwar Planning

In the postwar period the world will experience great transformations in not only the political map, but also in the economic and social life of nations. The problems to be solved are many and important, and each nation should be prepared to give the right and just solutions—lasting, rational, and constructive—to these economic, social, and political problems which are going to influence deeply the lives of small and large nations.

As an example, let us consider immigration, which is of great interest to Brazil and all Brazilians. The immigration problem cannot be faced without a previous geographic analysis and good maps of the region to be settled.

In postwar planning, it is also of paramount importance to have good and precise maps of the territories where great events are taking place.

[1] Inasmuch as the Second Consultation is fully covered in another paper in this issue, Dr. Leite de Castro's remarks on the program of the Consultation have been omitted. —Editor

With these tools, interpretation and investigation of regional potentialities and resources will be more complete, whether such developments are made by private or by governmental planning agencies.

So, it is now necessary that every surveyor, geographer, astronomer, geodesist, and topographer be at work, making maps of all types in which the physical and human factors of our world are represented adequately.

Brazil is being prepared actively for the postwar period by an intensification of political and geographic consciousness. Brazil will have great rights in the postwar world, to be given her by her effective contribution and participation in the war. Those rights are sacred, because they have cost her both material and human losses. At the peace conference Brazil will remember the Brazilian lives lost, her boats sunk, her co-operation in making available bases and raw materials, the economic hardships suffered by the population, the loss of markets, and finally, the Brazilian expeditionary forces which will be fighting soon, shoulder to shoulder, with their American brothers in the European war theater. This, by the way, will be the first Latin-American expeditionary force to fight outside the continent.

Brazilian geographers and surveyors are preparing for the role which they are going to play in the postwar period. Brazil already has a strong geographic and cartographic organization. The present Government is encouraging and developing these activities. Before this great geographic organization was laid down, a careful study of the actual conditions in all agencies interested in surveying, map-making, and geography was made; and it was discovered that there were several geographic agencies, some under the Federal Government, others under state control, and many in the hands of the most important counties (called *municipios* in Brazil). These various projects differed regionally and in character.

The Brazilian Government did not think it would be advisable to put all these cartographic and geographic agencies into one national agency. On the contrary, the policy was to create a supervisory and co-ordinating body—the Conselho Nacional de Geografía—which is in the Executive Office of the President and is in charge of the co-ordination of all cartographic and geographic activities of the Nation. It plans and carries out campaigns and undertakings with the co-operation of all agencies of the three spheres of Brazilian administration: the Federal, State, and County Governments.

The Conselho Nacional de Geografía

With the creation of the Conselho Nacional de Geografía, Brazilian cartography and geography witnessed great advances, and today the Conselho is working according to the following general policy and plan: First, the expansion and development of the existing geographic and carto-

graphic agencies; second, creation of new ones to act in specific regions or for specific purposes; and third, realization by the Conselho of some technical works necessary for the development of national projects and which cannot be executed by existing agencies.

The General Assembly of the Conselho meets annually in Rio de Janeiro. It is made up of technical delegates of the Federal and State Governments who plan and pass on the yearly activities, according to the most desirable methods of execution.

At intervals between the annual assemblies, the *Diretorios* function: these are in charge of making effective the plans agreed upon. There is a central Diretorio, made up of technical representatives of all ministries, which meets in Rio de Janeiro and promotes the execution of plans in which the federal agencies are concerned. In the states there are the regional Diretorios established in the capitals; these are in charge of the states' activities. And finally, there are the Diretorios in each of 1,636 Brazilian counties, which are in charge of the contribution of local material.

We thus established in Brazil a large geographic and cartographic organization, which is co-operative in character and is at present giving satisfactory results.

Our organization was made in accordance with a general scientific plan, in which were considered the major difficulties presented by such a plan, the immensity of the country (about 3,300,000 square miles), and its relatively small financial resources.

Therefore, we built up a mixed plan in accordance with which high accuracy surveying is executed, as well as reconnaissance and other kinds of surveying.

Under these conditions, and within our financial powers, it is becoming possible to execute some projects which cover all the national territory. Thus, in a relatively short time, we were able to survey and construct fair maps on the scale of 1:200,000 for all Brazil. Today we are able to present a fairly good cartographic and geographic documentation for all parts of Brazil.

Year by year, according to our plans, we intend to improve surveying and mapping methods, and we are replacing the less precise surveys with more accurate ones.

Surveying works are being developed intensively following a general plan of action. We are making astronomic determinations of co-ordinates of points with a minimum interval of 30 kilometers; first-order triangulation is being made, according to Pan American specifications; abundant reconnaissance and topographic surveys are being executed all over the country.

Office Cartography

Office cartography is also keeping pace with the field work, and official maps of all counties and territories have been prepared for more than 1,500 different projects. A base map of the country on the scale of 1 : 500,000 is now in a very advanced stage; there will be 150 sheets.

Finally, we are starting in Brazil the technique of regional analysis, which will soon be much intensified by the Conselho Nacional de Geografía. We have already made a preliminary study and division of the Country into 5 main areas, 21 regions, 62 subregions, and 124 physiogeographic zones. The idea is to analyze these 124 zones, which are geographic units and would serve as text material for the maps being made. These studies will be prepared by trained geographers who will have the opportunity to do much field work.

Today, as a result of the active work of the Conselho Nacional de Geografía, we are profiting from your experience in transferring the results of pure science to the field of practicality, and thus are putting academic knowledge at the service of man and state.

Before ending, I should like to take this magnificent opportunity to make an appeal to the authorities and technicians of the United States to help me in this work of scientific co-operation, which is a basic policy in my program for the Conselho Nacional de Geografía.

I wish to introduce, besides the European techniques, the American methods of surveying and mapping and the American approach to geographic problems. To accomplish this aim, it is necessary to have your co-operation for the acquisition of technical material and for lending us some of your technicians to help us in the training of our personnel.

The Conselho Nacional de Geografía is working out a major plan of intensive cartographic and geographic operations. This plan is being carefully drawn up and we are counting on the co-operation of United States technique and industry for its execution.

I am confident that your collaboration will be given; and I am hopeful of obtaining for my Country, very shortly and under favorable conditions, adequate instruments for our astronomic, geodetic, and topographic operations, as well as the establishment, on a definite basis, of the methods of aerophotogrammetry together with adequate printing facilities for maps.

I can foresee all this equipment at work in experienced hands. Its result will be great productivity. Thus, Brazilian geography and cartography, moving with definite aims, would demonstrate in the technical field the practical value of American science.

With such broad aims and with your help, Brazilian geography and cartography can make a great contribution to the solution of postwar

problems, because if half of the South American Continent is well known, the task of our national statesmen and planners will be easier.

I can assure you that the Brazilian Conselho Nacional de Geografía, in its great task, is wholeheartedly willing to aid in the realization of the clear vision of one of your great statesmen, Mr. Sumner Welles, who wrote in a recent article:

> If anyone may venture in this uncertain world to make a prediction, I would prophesy that in the years after the end of the present war, the two nations that would most swiftly forge ahead—because of the capacity of their people, because of their natural resources, and because of their entrance upon a period of rapid industrial expansion—would be Brazil and the Soviet Union.

* * *

Record Films

A SIMPLE and economical method of condensing and preserving vital records for an indefinite period is announced by Microcopy Corporation in the Microcopy Translite Hi-Reduction process. This is the application of microfilming to engineering drawings, as well as any other valuable record, document, drawing, map, or similar material kept in industrial manufacturing plant files. Because of the high-fidelity translite feature, it is particularly adaptable to engineering drawings, in pencil on transparent paper.

Microcopy, being a photographic record, is a faithful copy of the material microfilmed. The negative can be used to make copies on other pieces of film or to enlarge and make copies of the original in any size desired on tracing paper, cloth, or film.

For reading Microcopy, a Microcopy Multiple-Magnification Viewer is supplied in various models. This Viewer, operated on a motion picture film projector principle, is operated from a control panel. It facilitates finding locations on films by permitting enlargements to be made on the screen, as well as permitting any portion of the frame to be centralized within the frame for easier reading.—*Scientific American*, September 1944.

Land Surveying*

By R. GETTY BROWNING†

IN PREPARING this paper, the writer will endeavor to present the subject of "Land Surveying" from the standpoint that this branch of engineering is highly important; is of widespread interest; and should be a profitable field for the engineer, if he is prepared to do the work intelligently through all of its different branches.

The science of land surveying is, no doubt, among the oldest with which the engineer or surveyor has had to deal, yet it is apparent that the methods employed back through the years have not been greatly changed. Among the reasons why so little progress has been made in the methods of land surveying, probably, are that this subject is so closely allied with the legal profession—with its long established rules of procedure—and also that while the field work of earlier surveys and the writing of descriptions were often handled in a careless, indifferent, or inefficient manner by the surveyor, the property owner did not complain, because he did not know that the work could have been done better with but little increase in cost. Certainly it is just as important for the survey to measure up to all legal requirements as it is for it to be done in accordance with correct mathematical principles, yet it frequently happens that this co-ordination between the legal and mathematical phases of the work is not achieved.

Whether we employ a surgeon, an attorney, or a surveyor, our first consideration should be that he be a capable and reliable individual. Nearly everyone has had experience with a "cheap" workman and knows of the result of such employment. We never pay a capable workman too much for his services because, being well informed and interested in his job, he puts more into it than would a less efficient man who might demand less pay. Therefore, we always benefit by securing the best possible talent to do any work that we may have to do, even though the cost may be a trifle more.

Landowners and Surveys

By taking advantage of all modern equipment, aerial maps, etc., the surveyor can readily make a survey at minimum cost and at the same time deliver to his client a great deal more information regarding his property than has usually been done heretofore, and he can just as easily make sure

* Reprinted through the courtesy of the North Carolina Engineer, September 1944.

† Locating and Claim Engineer, North Carolina State Highway & Public Works Commission.

that all of the work is in accordance with correct legal practice.

No doubt if the landowner knew how well a properly informed surveyor could make a survey of his farm, or other property, he would gladly pay the slight additional cost rather than have the work done in a slipshod manner by a less reliable man. However, it is difficult for the average engineering graduate, or a poorly trained surveyor, to understand how to proceed with a complicated land survey without a little more instruction than the average engineering course gives him in college. It is necessary for him to understand how land titles are traced and recorded, how descriptions and deeds should be written in order that they may be accurate from an engineering standpoint and also thoroughly reliable with respect to their legality. He should know how to search for obscure or obliterated landmarks and corners, and how to replace them in accordance with the best evidence obtainable. He should be informed of the proper procedure where it is necessary to adjust property lines when every vestige of the original monuments and landmarks has disappeared. He should be proficient in explaining to his client the significance of the work which he has done and be prepared to give him an accurate map with all the necessary supporting data when he has finished the survey.

Starting the Survey

It would seem that an excellent way to handle a land survey would be to first secure from the owner, and the land records, every item of information pertaining to the land in question, and then proceed to identify all the corners of the property, if possible. This may require that a survey be made in accordance with early methods, using magnetic bearings and surface measurements, the object being to find the *original* lines and corners.

Assuming that all the corners have been identified by the use of proper methods of surveying, the testimony of reliable witnesses, or other conclusive evidence, the next step would be to connect them with careful horizontal measurements and angles measured with a transit. Following this the survey should be balanced and any material errors corrected or adjusted, and the area found. A map should then be drawn, a corrected description written and a report made to the owner, stating what work the surveyor found necessary and giving an explanation of any adjustments or errors found in the original survey. Permanent monuments, properly witnessed, should be placed at each corner.

If, in making the survey, some of the lines or monuments are found to be in dispute, and there is no positive evidence by which they can be replaced, the surveyor should run his lines and replace the monuments to the best of his judgment in view of all the facts at his command, and

then, for the protection of his client, it would be advisable to explain the situation to the adjoining owners and suggest that they enter into an agreement, accepting his line as the boundary between their properties. If this agreement is properly written and recorded, it will serve to definitely fix the boundary.

Making Survey More Useful

As the work progresses the surveyor will, of course, be able to sketch in many of the outstanding features of the property, such as creeks, springs, woodlands, cultivated fields, roads, buildings, etc. Usually this would require but little extra time or expense, but the result would be that when he draws the map, he can readily make it much more attractive and useful to the owner by adding this information.

If the positions of all the corners are calculated by latitude and departure, permanent monuments set, and the survey referred to the true meridian, preferably by an observation made on the property, and all this information turned over to the owner, it is easily seen how valuable this data might be in subsequent surveys in connection with the reestablishment of the boundaries of the property or for the purpose of subdivision.

In summarizing the contents of this paper, it is suggested that after completing a land survey, the surveyor should deliver to his client the following data:

1. A written report describing all the work that he found necessary in making the survey and calculations. This should include such items as an outline of the research necessary in the Recorder's office; the survey of the lines of adjoining property; the work required in identifying the lines or corners; the names of the witnesses consulted in ascertaining the location of obscure or obliterated lines or corners, as well as the preliminary work of surveying the boundaries. The report should also describe the accurate survey of the reestablished corners and give any pertinent information which would make the survey more useful and understandable to the owner.
2. A map should be prepared showing the property in question, the area and the corrected courses and distances after the survey has been adjusted. The map should show the name of the owner, the adjoining owners, the name of the farm (if it has one), a brief description of its location, the true meridian, the scale, the date when the survey was made, and the name of the surveyor.
3. Copies of any agreements which may have been entered into by the owner with adjoining owners for the purpose of stabilizing the boundary lines.
4. A copy of the balance sheet of the survey.[1]
5. A copy of an aerial map, suitably framed, upon which the farm outlines have been drawn.

[1] The original article contained a sample form of "Balance Sheet."

Map

of

Echo Farm

Richard Dixon, Owner

Near Silver Valley High School
Randolph County, N C.

Surveyed June 17-20, 1944
By E. W Segroves,
Registered Surveyor

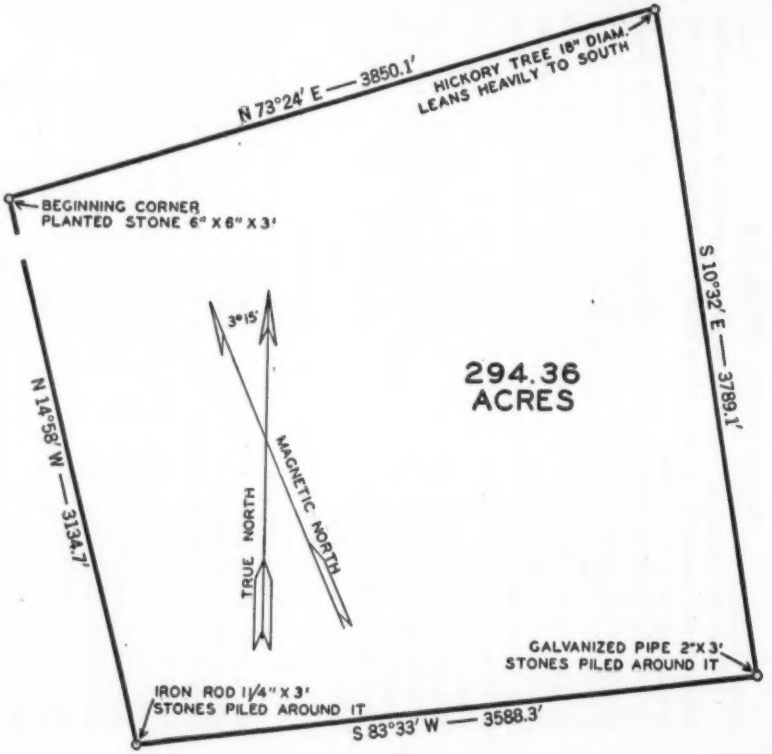
SCALE 1 INCH = 500 FEET

All bearings referred to true north.

All measurements made horizontally.

Declination of Magnetic Needle
3° 15' West

See Field Notes for Data on
Reference Points



Better Service—Better Pay

It is certain that if the engineer desires to earn more, he must deliver better service; and if he is prepared to deliver the service, then it should be made known to the public.

It seems that it would be advisable at this time to consider the passage of a law which would regulate the activities of the surveyor and serve as a protection to the landowner in matters of this kind. It appears illogical not to have this protection, when, as an example, we consider a case where a large country place is purchased and the owner intends to renovate it and establish an up-to-date home. If plumbing is required, it must be inspected and passed by the Plumbing Inspector. If it is to be wired for electricity, the installation must be inspected by the electrical authorities. If a water supply is to be put in, this must pass inspection of the Board of Health. But, if the boundaries of the property are to be retraced, too frequently an irresponsible, incompetent surveyor may be given the job without any assurance that he will do the work properly or honestly.

Suggestions for Legislation

I would like to suggest that, in an effort to improve the professional standing of the engineer, legislation of this sort might well be in order, and in my opinion the law providing for the Registration of Engineers and Land Surveyors, now in effect, is a step in the right direction, but this alone cannot guarantee that degree of service to which the public is entitled. I feel that all land surveys should be made by registered surveyors or engineers who have been thoroughly instructed in the proper methods of doing such work. If, for the present, this cannot be done, due to the scarcity of capable surveyors, it is, I think, most necessary that all surveys of record be approved by a registered engineer or surveyor before they are accepted for recording. Surely nothing is gained by recording data which may be inaccurate or misleading.

If it should be deemed expedient to undertake the passage of legislation to put into effect the ideas expressed in this paper, the following suggestions are offered:

1. The office of County Surveyor shall be established in every county.
2. The Surveyor shall be elected for a term of 2 years, subject to reelection.
3. His salary shall be fixed by the county at not less than $2,000 per year.
4. He shall be permitted to do a reasonable amount of private work, but he shall not engage in extended private practice.
5. The Surveyor shall examine and approve all maps and descriptions before they may be recorded in the land records.
6. The Surveyor shall cause to be prepared a map of the county showing all

land boundaries: (a) The county will provide a competent draftsman to do this work under his supervision.

7. As new maps are filed, the boundaries shall be placed on the county map by the Surveyor.

8. All land surveys of record shall be referred to true north, and all measurements shall be made horizontally.

9. The error of closure for rural surveys shall be not more than 1:2,000 and for city surveys not more than 1:10,000.

10. Descriptions filed with the Surveyor for examination shall be accompanied by the following data: (a) A map of the land described, drawn to a suitable scale. (b) A sheet showing the computations and the distribution of the allowable error of closure. (c) A description which recites the corrected bearings and distances shown on the map.

11. Maps filed for record shall indicate the name of the property owner, the general location of the property, the scale to which the map is drawn, the date when the survey was finished, and the name of the surveyor who did the work.

12. All corners established on new work shall be of permanent material, such as galvanized pipe, an iron rod, concrete or stone monuments, a hole drilled in rock, or some indestructible natural object.

13. When descriptions and maps are presented to the County Surveyor for examination, they shall be checked by him and if found inconsistent with each other, or incorrect, they shall be returned to the Surveyor for correction and resubmission.

14. Immediately after the passage of this Act, all surveys of record must be certified by a registered surveyor or registered engineer prior to examination by the County Surveyor.

15. All maps prepared for record shall be drawn on cross-section tracing cloth in order that they may be easily checked and that copies may be made.

16. Maps shall be plotted by latitude and departure methods, the area calculated, and the balance sheet copied on the map or attached thereto.

17. For the convenience of the surveyor, a true meridian will be established at every courthouse and high school in the State.

With the aid of suitable legislation, perhaps the Society could collaborate with our State College in working out extension courses, lectures, etc., for the benefit of those engaged in land surveying, and in this way bring about many badly needed improvements in the practice of this ancient art.

A COSTLY THIRST FOR NORTH CAROLINA

TRADITION RELATES that the copper mines at Copper Hill, Tenn., were lost to North Carolina because the surveyors ran out of liquor when they reached the area, and instead of continuing the State line southwest, they turned due south in the direction of a still.—*The Washington Star,* October 7, 1944.

Control Surveys and Beyond*

By CARROLL F. MERRIAM†

THE Pennsylvania Water & Power Company in the course of the development of two large hydroelectric plants, together with the building of 300 miles of transmission lines—a task which required not only detailed to[pog]raphy of 20 miles of river for the selection of dam sites, but also maps for the acquisition and recording of 1,812 parcels of property—has had varied experience in mapping, some good and some bad, but enough to demonstrate the general principle that whether a map is satisfactory in the final analysis depends primarily upon the accuracy of the control. Maps which are lacking in this respect sooner or later prove inadequate when more exacting demands are made on them and, consequently, must be superseded with others built upon a stronger framework, which generally has to be begun all over again. On the other hand, if the foundation is accurately established at the outset, then details may be added as the use is extended beyond the original purpose, without having to sacrifice any of the effort which has already been expended.

Having been brought in this way to realize the value of good control for maps made primarily for Company use, it is easy for this Company to appreciate how much more important it is to establish an equally good foundation for the maps which will be used by the public for the many and diverse purposes associated with the life of a community. When we consider how interlocked are our streets, sewers, electric facilities, railroads, and all of the things which go to make up the complex of modern life, the wastefulness of independent surveys made just for a single purpose is only too apparent. There should be some way in which all surveys could be so joined to a common base that each one serves to strengthen the rest and thus avoids duplication of work. What is wanted is, in effect, a "survey pool," in which every individual survey contributes something and to which anybody can go to draw upon the results of all previous surveys in a given locality.

The Pennsylvania Water & Power Company has been one of the leading exponents of pioneer investigations and experimental work in the hydroelectric and allied fields, the Company having learned during the past 34 years that if only a few of the many research projects undertaken prove successful, the results of these few will far outweigh the cost of many failures and unprofitable ventures, which could not have been fore-

* Condensed from paper presented at Annual Meeting, Washington, D. C., June 3, 1944.

† With Pennsylvania Water & Power Company, Baltimore, Md., and Collaborator, U. S. Coast and Geodetic Survey.

seen at the outset. Consequently, the Company has felt justified in lending support to scientific endeavor even though the probability of immediate profit to itself is not always apparent. This is particularly true in situations where the well-being of the community is concerned. In many of these cases the experience gained in such endeavor and the intangible by-products of research ultimately prove to be well worth the effort.

It is this attitude on the part of the Company that has enabled me to make certain researches in the field of control surveys—a field in which I developed a persistent personal interest while serving on the original Committee on Mapping of the Maryland State Planning Commission.

The Survey and the Surveyor

The subject which has intrigued me most is the carrying of control surveying to the step beyond the point where the triangulation parties leave off—that important connecting link between the survey and the surveyor. My hope has been to advance the time when the benefits of plane co-ordinates can be fully utilized. At present it is apparent that, no matter how obvious these advantages are from a theoretical standpoint, prejudice and ignorance stand in the way of progress, and that these obstacles will be broken down only by concrete example and demonstration. For a number of years I experimented until I was satisfied that there lies ahead of us a tremendous opportunity for material savings, but for a long time I could see little or no progress toward the practical application of plane co-ordinates in Maryland, in spite of the fact that the law had already been passed.

Experimentation

I have found in these activities the opportunity for investigating the potentialities in fuller use of plane co-ordinates. The following are some of the studies pursued:

1. Use of "ordinary" transit.
2. Use of transmission towers for survey points.
3. Simplified procedure to extend triangulation.
4. Three-point problem.
5. Reconciliation between plane grids.

1. *Use of "Ordinary" Transit.*—The first question which intrigued me was to see what limit of accuracy could be obtained with an ordinary transit, such as would be found in any surveyor's office. The test was made more exacting by using a one-minute instrument that had been so damaged by a fall that the frame was perceptibly bent; in fact, the "wreck" was not considered worth the $80 necessary to put it in repair. However, with a little attention to detail in field practice to eliminate instrumental errors and with only 11 repetitions, I secure almost invari-

ably a total horizon closure of under 6 seconds in three angles. In almost every case the sum of the three angles is less than 360 degrees, and only very rarely does it exceed this amount. Consequently, it seems logical to assume that this trend always to read less than the true angle is caused by the clamping of the plate or some other effect which operates always in the same direction. Therefore, since I turn consistently in a clockwise direction and distribute the error equally, the true error in the adjusted angles is probably less than the apparent.

2. *Use of Transmission Towers for Survey Points.*—Another of these questions is to determine whether high-tension transmission towers can be used as survey points. If so, there would be a number of advantages. In the first place, no contractor would be likely to dig them up or push them over with a bulldozer. They can be seen from long distances; they are numbered serially and can be found readily without having to grub about in the underbrush. They are always accessible and in cleared land, and, almost invariably, there will be visible also a distant tower to serve as a convenient azimuth mark. Furthermore, they can be picked out easily on aerial photographs because of the cleared right-of-way, and, best of all from the point of view of the surveyor, they can be used without cost.

The results of this experiment show that well-built towers, such as would be used for highly important lines, can be depended on for work of a high order of accuracy. So far, there has not been any evidence that deflection, caused by wind or varying tension of the wires or ground settlement under the foundations, has given rise to any difficulties.

3. *Simplified Procedures to Extend Triangulation.*—The third subject was to consider whether, after the main control monuments are set by the Coast and Geodetic Survey, there might not be some simple procedure, well within the grasp of the surveyor not versed in geodesy, by which the advantages of triangulation could still be utilized to extend control before depending on traverse. The purpose of the plane grid was to permit the surveyor to simplify his task and to unify his surveys so that they would fit together into a connected whole. Should we now stop merely with the establishment of the grid, or should we attempt to show how it can best be used?

The adjustment of a triangulation net even on a plane system is at best a complicated task, requiring patience and more expense than the surveyor's client can ordinarily afford. The solution of the plane oblique triangles and the subsequent determination of the co-ordinates of the corners, to say nothing of the errors to distribute, is something to avoid if a practical method of giving the same results directly could be substituted. The answer lies, in my opinion, not in the field of plane trigonometry, but in analytical geometry. Do as you would if you were to solve the figure

geometrically, but use equations instead of protractor and straightedge. The result is a technique of remarkable simplicity, and, with the aid of a calculating machine, the labor is greatly reduced.

An unexpected advantage in this method is that the error in intersecting from three or more points is reduced to concrete form where it can be dealt with easily. The problem of determining in advance what combination of sights will probably give the best results, and the need for avoiding a surplus of observations which will lead to indeterminate solutions are automatically eliminated. Just use everything you have and then plot on a large scale the intersections of the various combinations of sights. The good sights confirm each other, whereas the bad ones leave no doubt as to their falsity. Furthermore, the size of the diagram indicates very clearly the dependability of the result.

4. *Three-point Problem.*—A fourth line of study is intended to overcome the objection of the high cost of interconnecting traverse to join a property survey to the nearest established monument. Theoretically the three-point problem offers a solution wherever three established landmarks, such as steeples or water tanks, can be seen. The drawback is that the computations are so involved that this method seems to have found little practical application. Although still in the experimental stage, the tests that I have made to try a method based upon simple principles of analytical geometry have shown that highly satisfactory results are possible. I do not believe that the method is too complicated to be mastered by a computer such as the land surveyor might employ. Furthermore, when more and more prominent landmarks are co-ordinated, the practicability of this means of bridging the gap between the property survey and the grid should increase. The co-ordination of transmission towers ought therefore to be a definite step in extending the use of statewide grid co-ordinates into the territory through which these lines pass.

5. *Reconciliation Between Plane Grids.*—A fifth endeavor was stimulated by a remark made at a Committee meeting to the effect that the State grid co-ordinates could never be reconciled with the local grid in Baltimore City. This challenge led to the development of a formula for converting from one to the other and vice versa. It is not based upon the theoretical relation between the two, but upon common points, the co-ordinates of which were given in both systems. This formula takes into consideration not only the varying scale factor in the Lambert grid, but also the fact that the City of Baltimore and the Coast and Geodetic Survey have never come to absolute agreement as to the length of a certain line upon which the Baltimore system is based.

Actual tests have shown that excellent work can be done using fundamental data taken from both systems reduced to common terms by means of this formula. Consequently, there appears to be no need of adjusting

the two surveys to perfect agreement because, as far as reduction to a common basis is concerned, there is nothing more to be gained. It should be remembered that any adjustment on the part of either net to conform with the other might necessitate recomputation of hundreds of co-ordinated points. The formula seems to be a happy solution for cases where local and nation-wide surveys differ, since all of the advantages are gained without any of the disadvantages.

Extending this idea further, a corresponding formula for reduction of the U. S. Engineer net for Baltimore Harbor has just been developed, so that at the present time one may use any one of three systems he finds the most convenient, and still have the advantage of being able to draw upon any of the established control points as co-ordinated in the other two.

In connection with the laying out of the Maryland state grid on existing maps, it was found useful to have a table of co-ordinates for each 15-minute intersection. With this table any of the older Geological Survey quadrangles, which do not have marginal ticks, can be quickly co-ordinated; but since many maps show longitude and latitude in 20-, 10-, or even 5-minute intervals, this table was later broken down to 5-minute intersections. It has also proved useful from another point of view; for, when it was desired to plot traverse points given in terms of geographic positions, a method of double interpolation was developed for rapid machine computation which gave results well beyond the accuracy of plotting. In fact, by making a small supplementary correction for the curvature of the parallels, an accuracy of about a foot could be obtained.

Company Interest

Returning now to the Company's interest in the matter. Since we have over 1,800 pieces of real estate to guard against encroachment, it is certainly desirable to encourage any means by which they may be definitely referenced to a firm and unshifting base and to have them appear on record maps exactly where they are. Looking back upon the experiences encountered when acquiring rights-of-way, the advantages of being able to go to official maps and see just whose land must be negotiated for —instead of blindly copying deeds, plotting them, and then trying to match them with photographs just on the chance that they might be needed—appeal strongly to the Company's Real Estate Department. Even to be able to account for every inch of the way, without danger of overlooking some small but troublesome property, holds a tempting prize for that future day toward which we can at the present only strive.

But apart from the value which we may hope to realize in the future, the application that the State police and the Department of Forests and Parks has made of these co-ordinates has a direct bearing upon the protection of our lines and property against the dangers of fire and sabotage.

Our transmission patrolmen are being equipped with strip maps of the lines they patrol, these maps being co-ordinated in order that they may work more effectively with the police and fire wardens.

But this is not all; the application of co-ordinated surveys for uniting and bringing to a common basis maps and plans for the many interlocking facilities in a modern community is as yet only in its infancy. In the normal course of conducting a utility business, the opportunities for taking advantage of unified control will certainly become manifold, particularly as postwar planning gets seriously underway. Already we see maps, which were begun before precise control was available, reaching the point where revision becomes imperative, simply because the distortion which was unimportant at the start becomes intolerable as more and more details are added. The grid co-ordinates and referencing to well-established monuments offer the solution to an otherwise troublesome problem.

Conclusions

Even though this experience has been confined to but one state and one utility company, nevertheless it has been sufficient to point to certain definite conclusions. The potentialities of the State Plane Co-ordinate Systems for effecting economies in surveying and mapping and for simplifying land referencing are enormous. Effort should be made to hasten the time when their full value shall be realized. It is not necessary to wait for legal recognition of the state grid before making practical application of co-ordinates. Each state should now be laying the foundations for a central office to serve as a clearing house for the manifold mapping problems which will arise, and to establish a more effective liaison between the state and the U. S. Coast and Geodetic Survey and other federal agencies.

Finally, there is one deduction that I should like to emphasize above all. With the enormous field ahead the engineer ought not to fear any lack of employment, but this work is not going to come to the engineer "by gravity," as we might say; he has got to go after it. I am convinced that after the war the public will tend to become just as apathetic as it always has been between wars since the first map was used to try to arouse a spark of interest among the Spartans concerning the danger of impending Persian invasion. We cannot afford to sit back and say, "Let us have your specifications and we will make your maps." Our attitude must be, "Let us know your problems and we will show you how to use maps as you have never used them before."

"There are some who have not even learnt to read maps."

—C. E. Montague.

Surveying and Mapping in the Americas*

By COLONEL GERALD FITZGERALD†

HAVING just returned from a two weeks' inspection trip of various Aeronautical Chart Service units scattered around the country, I have had little time to prepare a formal paper for this meeting. Moreover, in looking over the program, I find myself bracketed on the south by the distinguished engineer and geographer, Senor Leite de Castro, and on the north by my good friend, Mr. F. H. Peters, the Surveyor General of Canada. In addition, I am almost completely encircled by necessary War Department regulations governing the dissemination of restricted information. This situation, together with the time allotted, would appear to limit my remarks to a very brief description of topographic mapping in Kansas. I propose, however, within my limited capabilities and with your indulgence, to make a rapid reconnaissance of some of the mapping and charting activities between Point Barrow and Cape Horn, with which, under our war program, I have had some direct or indirect connection.

Since any discussion of mapping and surveying in the Americas must include some mention of our domestic topographic mapping program, I shall first say a few words about what has been accomplished under wartime conditions, and what remains to be done in the postwar period. I realize, of course, that this is a big subject and should be covered by a more competent authority; however, as it seems to be part of this program, I will review some of the information I have on the subject.

Prewar Mapping

Prewar topographic mapping in the United States and Alaska, as you all know, proceeded at a snail's pace with limited funds appropriated by Congress for the Geological Survey. The tempo of this work has increased considerably during the past several years with funds made available to the War Department and with most of the program under the direction of the Chief of Engineers. Both control and topographic mapping have been carried on by engineer troops in training, by the Geological Survey, the Coast and Geodetic Survey, the Tennessee Valley Authority, the Forest Service, the Soil Conservation Service, and other federal bureaus. Commercial mapping organizations, such as Aero Service Cor-

* Presented at Annual Meeting, Washington, D. C., June 3, 1944.

† Chief, Aeronautical Chart Service, U. S. Army Air Forces.

poration, the Fairchild Company, and others, have contributed materially to this mapping program. Standard mapping specifications have been followed as closely as the experience level of personnel and the type of equipment used would permit. It is not a violation of military security to state that hundreds of good quality new quadrangles have been added to the topographic atlas of the United States with the aid of wartime appropriations.

Most of us realize, I am sure, that this program is only a temporary "shot in the arm." As a matter of fact, the patient has already had a relapse—military operations requiring the diversion of funds, personnel, and equipment to the mapping of actual or potential theaters of war far from continental United States. This situation will probably not change materially until after the cessation of hostilities.

Domestic Mapping

Domestic postwar mapping—that is, the mapping of the United States, its territories, and insular possessions—will require aerial photography and modern photogrammetric methods if the job is to be completed within the next 25 years.

As time is an important factor and funds are often difficult to obtain for the photography of some of the large unmapped areas in western United States and Alaska, consideration should be given to the use of military photographic aviation for this purpose. The vital importance in wartime of photography for reconnaissance and mapping is an established fact. Continual operational training in peacetime is necessary if Air Forces units are to maintain the high standard of equipment and personnel developed during the past 2 years—routine training could well be diverted to productive effort for the direct benefit of the nation as a whole.

Topographic mapping of standard scales and specifications can be handled by existing Government agencies which are already equipped and have personnel trained to do the job. The Geological Survey—in normal times the Federal Government's principal mapping agency—has obtained a large amount of new equipment and has trained new personnel in modern photogrammetric mapping methods, making it capable of meeting the rigid specifications required for various scales of topographic mapping. There has been developed for this war program an annual productive capacity which more than doubles the Survey's average annual production in domestic mapping for the past 2 years.

The full import of this development on postwar mapping is significant when we consider that the present rate of production has been attained in the face of difficulties in securing personnel and in spite of serious losses of trained personnel to the draft. With the return of trained topographers and engineers after the war, the Geological Survey, and such other

federal agencies as may be required, should be able to carry out any mapping program for which funds may be provided by Congress.

Hemisphere Mapping

The Army Air Forces aeronautical charting program is, for many obvious reasons, world-wide in scope. Western Hemisphere coverage alone includes nearly 1,000 different aeronautical charts, at various scales, which are required to carry on Army Air Forces operations. The total area involved is more than 16,000,000 square miles.

Long before Pearl Harbor our military transport required charts of the Western Hemisphere air lanes which were immediately put into compilation. It soon became apparent, however, that, with the exception of the United States proper, existing base map information was not adequate for compiling charts at a scale of 1:1,000,000. In an effort to remedy this condition with all possible speed, the Army Air Forces inaugurated the tri-metrogon photographic program early in 1941. Because of the demands of air transport, certain Western Hemisphere photography at that time was high on the priority list. Since the first charting photography was accomplished in Alaska, more than 4,000,000 spare miles in Alaska, Canada, Mexico, the Caribbean, and South America have been photographed by military aviation. Of this area, more than 3,000,000 square miles have now been compiled into base maps for the production and revision of aeronautical charts. Most of the original compilation was done at a scale of 1:80,000, with reductions for drafting and publication at scales of 1:250,000, 1:500,000, and 1:1,000,000. In many critical areas 1,000-foot *form* lines have been added to the planimetric compilation, and spot elevations, suitable for publication on aeronautical charts, have been computed. The reconnaissance mapping already accomplished, much of which is already published, should be of great value in planning and executing control surveys and topographic mapping at larger scales.

In conjunction with the accomplishment of aerial photography and photogrammetric compilation, specially trained units of the Army Air Forces—operating sometimes with dog team transportation far north of the Arctic Circle and often with canoe and burro far south of the Equator—have established 472 astronomical positions for control. A similar number of positions have been established for the Air Forces charting program by our allies, friends, and neighbors in the Americas.

All of us in the United States Army Air Forces who have been closely associated with the mapping and charting program in the Western Hemisphere are deeply impressed with the fine spirit of co-operation shown by all the countries which have participated in this effort to improve mapping and charting in the Americas. It has brought to all of us a common

bond of endeavor, which has not only contributed greatly to the wartime charting program, but has also stimulated a renewed interest in all phases of surveying, mapping, and cartography. When the complete story of this entire program can be told, I am confident that history will record this wartime contribution to geographic knowledge as a phenomenal achievement.

❦ ❦ ❦

Assessors Group Backs Project for Tax Maps

PREPARATION OF TAX MAPS for Chautauqua County, N. Y., through aerial and engineering surveys, received overwhelming endorsement at a meeting of the Chautauqua County Assessors Association.

In counties where tax maps have been set up, it is understood, extensive lands have been "found" that had gone untaxed for years because they were "lost" to assessors. Likewise, properties that had been improperly assessed were brought to light.

In compiling such maps, a preliminary aerial survey is made as a basis for engineering surveys and an extensive study of deeds, permitting an accurate reflection on records of all real property in the county.—*Jamestown Post-Journal*, June 17, 1944.

❦ ❦ ❦

Three Billion Dollar Program for Reclamation

FIELD STUDIES, plans, and specifications are rapidly being advanced by Bureau of Reclamation engineers for a $2,953,000,000 five-year construction program in 17 western states, based on the price levels of 1940. Of this amount, $2,670,000,000 would be spent for actual construction, and the remainder for land, right-of-ways, pre-construction work, overhead, and other incidental charges. A total of 236 projects to provide water for irrigating 6,705,000 acres of new land and supplemental water for 9,365,000 additional acres are planned.—*Engineering News-Record*, September 7, 1944.

Curvature and Refraction Tables for Topographic Surveys*

By CAPTAIN N. B. FAVELL

IN a series of articles published at different times in the EMPIRE SURVEY REVIEW, the writer has stressed the utility of the slide rule in topographic work for both mapping and engineering purposes. It is his opinion that every topographic surveyor should be thoroughly conversant with the slide rule, and that there is no difficulty in teaching anyone, even with limited educational qualifications, all that is necessary about it. One advantage of its use is that the plotting-scale divisions need not represent any simple multiple or fraction of the normal units of length, but can be chosen so that the subdivisions cause no undue eye strain. This plotting scale can then be used for work on any scale, all necessary tables being calculated and constants adopted for use with it, without any extra work being required. A scale of 1: 250 (1 foot divided into 25 main and 250 minor divisions) was found to meet the case.

Take for instance the table for corrections to heights for curvature and refraction. Such a table can be compiled, for any given combinations of coefficient of refraction and scale of plan, direct from one setting of the slide by the following method, which is based on the article in EMPIRE SURVEY REVIEW, October 1939, "The Slide Rule in Coastline Mapping," by P. A. Clayton.

Suppose the scale of the planetable is 2 miles to an inch and the coefficient of refraction is $k = 0.064$, then one main division of our plotting scale = 5,069 feet. From formula (1) of the Editorial Note to the article referred to we have:

$$h = s \tan a + \frac{s^2(\frac{1}{2} - k)}{r} \sec^2 a + \ldots$$

where h = the difference in height between two points,
s = the distance between them,
a = the vertical angle of elevation or depression,
k = the coefficient of refraction,
r = the radius of the earth.

For topographic purposes, where the angle a is small, we may take $\sec^2 a$ as unity and so get as our correction for curvature and refraction:

$$\frac{s^2(\frac{1}{2} - k)}{r}, \text{ or } \left(\frac{s}{\sqrt{r/(\frac{1}{2} - k)}}\right)^2.$$

---

* Reprinted through the courtesy of Empire Survey Review, April 1944.

Now if, in the case in question, d is the plotting-scale measurement between the two points, then

$$s = d \times 5{,}069,$$

and our formula for the correction becomes:

$$\left(\frac{d}{\sqrt{r/(\tfrac{1}{2}-k)}/5{,}069}\right)^2.$$

Now $k = 0.064$ and $\log r$ (in feet) $= 7.32021$.
Hence, correction for curvature and refraction in feet

$$= \left(\frac{d}{1.366}\right)^2.$$

Set this constant 1.366 on the C scale of the slide rule opposite to 1 on the D scale. Set cursor to any distance (in plotting-scale divisions) on the C scale and read on the A scale the correction in feet, and so compile the required table of corrections from one setting of the slide.

Decimal Point Locator Slide Rule

USEFUL in solving difficult problems, even by persons with a limited mathematical background, a new slide rule and decimal point locator, called the "Deci-Point," will determine the decimal point mechanically in involved expressions with results up to 19 digits or 19 zeros. It also obtains 30-inch scale accuracy for cube root and 20-inch scale accuracy for square root on a rule with 10-inch scales. With one setting of the hair line this device will read square root, cube root, and logarithm; similarly, with one setting of the hair line it will determine the number of digits or zeros in the square root or cube root. (Pickett & Eckel, 53 West Jackson Blvd., Chicago 4, Illinois.)—*Engineering News-Record,* October 5, 1944.

Blueprint Evaluator

SCARCE MATERIALS, man and machine hours, and personnel will be saved, it is claimed, by a new "Legimeter"—a device to predetermine whether a drawing will reproduce satisfactorily. The Legimeter is a two-panel illuminated table. Samples of drawings from which satisfactory prints have been made are mounted in the first panel; the second panel is a clear sheet of ground glass on which the draftsman places the drawing to be evaluated. Both panels are illuminated by transmitted light of the same intensity, for accurate comparison.

The Legimeter includes additional devices for the training of inexperienced draftsmen. (Invented by Douglas J. Wishart, The Glenn L. Martin Co., Baltimore, Md.)—*Engineering News-Record,* May 18, 1944.

Federal Surveying and Mapping Agencies

This is another in the series of sketches of the history, purpose, and scope of activities of federal agencies engaged in surveying and mapping.—EDITOR.

OFFICE OF INDIAN AFFAIRS*

Department of the Interior

HISTORICAL

CONGRESS, by the act of August 7, 1789, created the War Department and assigned to it, among other duties, those relating to Indian Affairs. The Bureau of Indian Affairs was organized in that Department on March 11, 1824. The act of July 9, 1832, created the office of Commissioner of Indian Affairs, who was to have, subject to the Secretary of War, and the President, "the direction and management of all Indian affairs and all matters arising out of Indian relations."

On June 30, 1834, legislation was enacted to provide for the organization of the Department of Indian Affairs. This act has been considered the organic law of the Indian Bureau.

It was not until the act of March 3, 1849, that the administration of Indian affairs passed from military to civil control. That act created the Department of the Interior.

Section 441 of the Revised Statutes provides that "The Secretary of the Interior is charged with the supervision of public business relating to * * * the Indians."

Section 463 of the Revised Statutes reads:

"The Commissioner of Indian Affairs shall, under the direction of the Secretary of the Interior and agreeable to such regulations as the President may prescribe, have the management of all Indian affairs and of all matters arising out of Indian relations."

Many treaties and agreements have been made with Indian tribes and many laws have been enacted relating to the affairs of approximately 200 separate bands or tribes of Indians scattered throughout 28 states of the Union. Treaties, agreements, and acts of Congress, cumulative over a long period of years, have expanded the scope of Indian business. Day schools, boarding schools, hospitals and sanatoriums, and irrigation projects have been built for Indian use; forestry and extension work have been undertaken; heirs of deceased Indians are determined through direc-

* Prepared in the Office of Indian Affairs.

tion of a specific enactment; and local administrative headquarters have been established to handle the ever-growing Indian business.

Maps and Surveys

Maps prepared by this Office for use in connection with forest and range management are of two general types: topographic and planimetric. All maps are drawn on the polyconic projection. Base maps are carefully prepared from the most reliable data available. These data are obtained from field surveys made by the Indian Service, the General Land Office, United States Geological Survey, and aerial maps made by the various branches of the Federal Government. The data usually recorded on our base maps are drainage, General Land Office land surveys, and such topographic features and cultural developments as are needed in forest and range management and other activities of the Indian Service. Topographic maps have been prepared for a number of reservations. The data for these maps were obtained from field surveys made by the Indian Service and from the United States Geological Survey quadrangles.

Most of the maps are made on two scales: one-half inch to the mile (1:126,720) and one-quarter inch to the mile (1:253,440). In most instances these scales are sufficiently large for general field work. Where necessary, larger-scale maps are prepared for timber sale units and for other units of forest and range land on which special work is done. The larger-scale maps are needed to show in detail the data with respect to the forest and range resources and topographic and cultural features which affect their management.

Maps used in forest and range management show the data as accurately as conditions will permit. This is especially true in fire protection where fires are located by triangulation. Lookout stations must be accurately located for the reason that they are used as triangulation points from which azimuth readings are taken on fires as much as 15 or 20 miles distant. Those who are familiar with the location of distant fires or other objects by triangulation can appreciate the need of accuracy in maps used in this work. Fires should be located within the smallest legal subdivision possible which should not in any instance exceed 40 acres. In unsurveyed areas the location of fires must be described by their relationship to drainage, topographic features, roads, trails, and other developments.

This Office also prepares maps showing land ownership on the various Indian reservations, contour maps of Indian irrigation projects, and maps of reservation road systems.

Our survey work is limited to the retracement of established lines and engineering work done in connection with our irrigation and road projects.

A Combination of Surveying Methods is Best*

By PAUL VAN BUSKIRK†

TOPOGRAPHIC surveying should benefit from the discussion that M. F. Denault started so well in his article "Plane Table Versus Transit for Topographing Mapping," in *Engineering News-Record,* May 4, 1944.[1] There is too little use of stadia, paradoxically due to its advocates, who are continually laying too much stress on long shots; the "long shot" field now belongs to the photographic mapping people. Graphic methods are used too little and too many jobs are cross sectioned, because it is "simple," although the "breaks" are seldom taken and less often plotted correctly.

Few surveymen know that a sturdy circular stadia slide rule can be had for one dollar. The tape rod is rejected because it is not "accurate," by the same man who uses his H.I. to the nearest tenth of a foot and reads his side shots the same way. In a similar way too much attention is given to the trivial f plus c correction, which does not show when plotted, and is best taken care of by advancing the index hair a hundredth when taking a reading.

Specifically, the author wishes to add to the discussion of the Baltimore or Shirley method of topographic mapping, which has been revived and improved. This method is now used widely in the Detroit district, even by organizations owning planetables. Variations in this procedure have shown that a combination of methods is best for topographic work.

Engineers of one large local organization use their planetable as a field drawing board only, depending on a 10-inch diameter celluloid protractor with graduated cross bar for plotting transit shots. The protractor is pivoted at the station, another needle is inserted against its edge on the meridian and shots are plotted as read, reduction being by a circular stadia slide rule. Ordinary Philadelphia or Frisco rods are used, long shots being avoided. Station elevations are established, the rod reading at the instrument determined and all shots taken as inclined sights on that reading. The usual scale is 100 feet per inch.

We depend on the transit for all our topography, but use some unique equipment for determining elevations and for field plotting shots. We field draw all our work on the newly developed white pencil tracing cloth, which is almost waterproof, using very hard pencils for accuracy of line

* Reprinted through the courtesy of ENGINEERING NEWS-RECORD, August 24, 1944.

† The Huron-Clinton Metropolitan Authority, Detroit, Mich.

[1] Reprinted in SURVEYING AND MAPPING, July 1944.

and to prevent smudging. The drawing table is made from a stock 20- by 26-inch board, having a built-in white celluloid protractor, the 10-inch center circle being free to revolve and having one radius graduated carefully to the required scale (fig. 1).

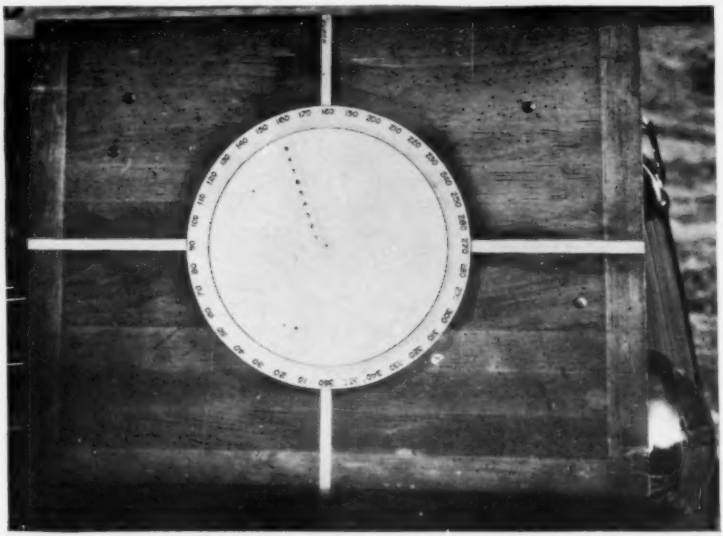


FIGURE 1.—Drawing table with built-in celluloid protractor.

The control stations are plotted on the sheet, a meridian line being drawn near the middle and the known data added. The plotted position of the occupied station is centered carefully on the disk and the sheet is oriented by bringing its meridian line parallel to the board meridian. As the transitman calls the azimuth, the topographer revolves his scale to that reading, plots the distance as it is given him, then inserts the proper elevation figures. Great precision can be attained in plotting shots by this method. The white celluloid background makes it possible to bear down on the pencil and get opaque contour lines, which will yield blueprints direct. Moreover, the lines will not smudge, and so make a good permanent record.

At each new setup the sheet must be moved, but orientation is kept accurate by always scaling from the sheet meridian. While mapping sections on which only the exterior and quarter lines were run as control, we

often traverse seven or eight stations and close back into our control with an error of about 0.05 inch when working on a 200-foot scale.

Rapid Plotting Possible

Plotting is so rapid by this method that one rodman cannot keep up, while two rodmen put the transitman behind with his elevation reductions. This bottleneck was broken by using tape rods of the type shown in figure 2, which permitted the bubble-level elevations to be read directly and made the reductions of inclined shots an easy mental subtraction, as illustrated graphically in figure 3.

The ease with which shots may be reduced and plotted makes for much better field work. With the board mounted on a tripod and approximately oriented near the transit, errors in azimuth and distance readings are at once detected by the topographer. In bad weather the topo-table can be operated inside a car if it is possible to drive within hearing distance of the transitman. Good speed can be made with two regular rods, if the transitman knows the visual method of counting above or below his datum rod reading and if he sets the center hair of the instrument on the datum rod reading for inclined shots.

By the method just outlined the field checking advantage of the plane-table method is utilized, with the greater strength of the transit readings. Locations by intersecting angles can be made, and resection and three-point location can be done by using an extra sheet. The equipment works well on 200-foot scale jobs, as a quarter section can be done on one sheet. Only 40 acres can be done to a sheet at 100-foot scale, but for strip work 3,000 feet may be done on a rolled sheet.

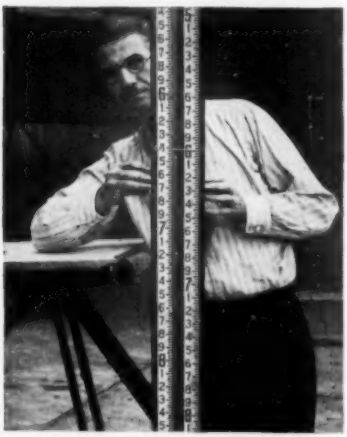


Figure 2.—Use of tape rod increases speed.

A variation of the method outlined was devised for 50-foot scale work by Maurice Baldwin of our staff. He uses the tracing cloth on a plane-table, slips a 14-inch diameter cardboard protractor under it, centers and orients, then scales on the top with a white-edged scale pivoted by needle point at the station. This permits much larger sheets to be used in the field. Successful use of the method requires

that the center point of the protractor be marked with a small circle and covered with thin celluloid, to prevent the needle hole from becoming inaccurate.

To summarize, no one method is satisfactory for all surveying jobs. The engineer should select the best method or combination of methods for the work in hand. But field drawing of details is one item that should be included in any method selected.

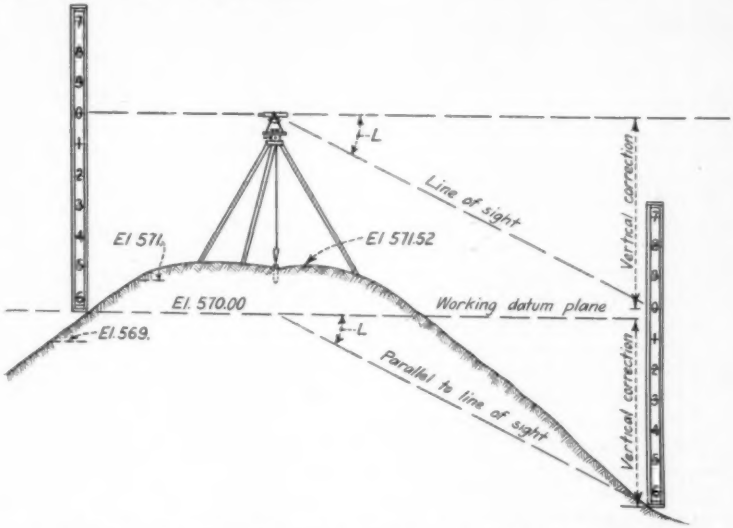


FIGURE 3.—Tape rods make reduction of inclined shots an easy mental subtraction. (Set the rod on a stake of known elevation and move the tape until that reading comes to the level line of sight, then clamp the tape. All bubble-level shots now give the last three figures of elevation on which the rod sets. All inclined shots taken to zero mark on the rod will be parallel to a line from bottom of rod to a point below the instrument in the 10-ft. datum plane; hence vertical corrections can be made directly to 10-ft. datum.)

"And on those charts I saw the small black dots,
That were called islands, and I know they had
Turtles and Palms . . ."

—W. H. DAVIES.

Surveys and Maps in State Planning*

By ELISABETH M. HERLIHY
Chairman, Massachusetts State Planning Board

THERE are two fundamentals of existence over which man has no original control—first, his own life and, second, the natural resources upon which that life is primarily dependent. Under our Constitution we have attempted to safeguard and protect the human race in guaranteeing to it life, liberty, and the pursuit of happiness; and we have taken steps to insure to the individual certain elements essential to his daily well-being—food, clothing, and shelter—but, in large measure, we have stopped there. The tremendous opportunities available to us through a beneficent Providence—land, water, and mineral resources—have been too often a matter of haphazard determination in each area, if indeed they are determined at all. Fortunately, however, through the efforts of your own organization, and through workers in the planning and engineering fields, progress is being made in legislation and, in certain respects being translated into action, providing for the necessary sub-surface, surface, and aerial surveys which are basic to effective comprehensive planning on federal, state, and local levels.

The chief difficulty I encountered in preparing my material for this paper was the absolute lack of any negative arguments, thus depriving me of any opportunity for rebuttal. There are supposed to be two sides to every question, but in the present instance I could discover nothing but complete unanimity of opinion with regard to the desirability and even the necessity for accurate and comprehensive surveys of our Country and the natural resources which have made it great.

It is not my province here today, nor indeed is it within my abilities, to discuss the technique of such surveys. Rather shall I endeavor to show the need for them in planning work, and the advantages that have accrued when the results of such surveys have been made available. Our work lies in parallel fields and each one should serve to strengthen and support the rest.

The Commonwealth of Massachusetts

First, in the interests of orientation, it might be well to give you a few underlying facts and figures. The Commonwealth of Massachusetts contains an area of 5,179,536 acres and measures generally 150 miles from east to west and 50 miles from north to south. While I do not hold with one inspired writer who declared that Massachusetts is bounded on the

* Condensed from paper presented at Annual Meeting, Washington, D. C., June 3, 1944.

east by the Atlantic Ocean and on the north, west, and south by all the people who claim the Bay State as their own, through birth, ancestry, education, instinct, or because they like to spend their vacations there, it is nevertheless a fact that the original grant of land, in 1624, to one John White, an English Puritan, consisted of all the territory included between 3 miles north of the Merrimac and 3 miles south of the Charles in one direction and the Atlantic and Pacific Oceans in the other. In our modesty we have reduced this east-west dimension considerably, claiming only an average of 150 miles of our original heritage of 3,000. Our population, as of the 1940 Census, was 4,316,721, thus establishing us as the third most densely populated of the 48 states, with a population density of 545.9 persons per square mile.

Early Massachusetts Surveys

Historically speaking, the first constructive step in survey work appears to have been taken in Massachusetts in 1829, more than a century ago, when a committee was appointed by the Legislature "to consider the expediency of determining a map or maps of this Commonwealth as the public exigency requires and report thereon to the next session of the Legislature." While this in itself was little more than a gesture of recognition, it was followed in succeeding years by further and more detailed instructions.

In 1830 a Resolve was adopted directing each city, town, and district of the Commonwealth to make a plan of its territory on a scale of 100 rods to an inch and to file such plan with the Secretary of State before June 1, 1830. At the same time a Resolve was passed directing the Governor to appoint a surveyor to make a skeleton map of the State with the idea of fitting into it the information to be made available from the various towns.

In 1884 the Massachusetts Legislature authorized the setting up of the Massachusetts Topographical Survey Commission, which was instructed to co-operate with the United States Coast and Geodetic Survey in completing the necessary control for the preparation of a contour topographic survey and map of the Commonwealth. A few years later the definition and preservation of town boundary lines were added to the duties of the Commission. The work was finished in 1915, and while as a result there was available a set of maps showing every city and town in the State, and to that extent it was valuable, perhaps its chief merit was to be found in the fact that it pointed the way to the setting up of the Massachusetts Geodetic Survey in 1933 under the direction of Elmer C. Houdlette. Beginning under CWA, through ERA, and finally WPA, Massachusetts is one of the few states in which the work was finally completed. While its usefulness will depend upon the extent to which the local communities co-operate and carry on to the end that all future local work shall be tied

in to the State system, a single instance of its value may be found in the direction of improved forest fire control. At the request of the Department of Conservation, arrangements were made to tie in the fire towers throughout the State with the triangulation work carried on by the project, an arrangement that hitherto had been impossible.

Mr. Houdlette's work did not stop with the State, however, but reached out to various municipalities to which he gave generous assistance, advice, and co-operation. In Boston, for instance, a geodetic survey was undertaken by the City Planning Board, the purpose of which was the making of an official map of the City. Fifty years earlier the Board of Survey, as it at that time existed, mapped a considerable portion of the City. Even though the work was terminated in 1895, unfinished, it has served a most useful purpose in the opening up of hitherto undeveloped areas. The City Planning Board survey therefore was an attempt to retrieve and expand that work, using the latest accepted technical methods. The work was carried on for nearly six years, with the assistance of federal funds, and the triangulation portion of the control survey was completed over the entire city. The unfinished work, or partly finished, of which there is a great deal, has been carefully filed for future use when conditions are such that the work can be revived.

A New Topographic Map

The Commonwealth of Massachusetts, through the Department of Public Works, is now co-operating with the United States Geological Survey in making a new topographic map of the Commonwealth. The work was started in 1934 and has been carried on continuously since that time. To date 105 sheets have been published out of a total of 188, a considerable number are in preparation, and preliminary work has been carried out over the rest of the Commonwealth.

On these maps, highways and other cultural features are shown in black, the elevations of land are shown by contours in brown, and the water areas are shown in blue. The classification of the principal traveled roads is indicated in red. Automobile route numbers are also shown and, if desired, the map can be obtained with a green overlay showing the wooded areas.

The names of streets are given where it was possible to obtain them. A large number of bench marks and monuments are shown which are included in the State Co-ordinate System. Index marks appear on the borders of each sheet, so that the co-ordinate lines of either the State or the military system may be drawn if desired.

These maps are published at a scale of 2 inches to the mile. There is a possibility—if agreeable to the sponsors of the survey—of enlarging portions of these maps even to a scale of 800 feet to the inch, thus making

them entirely satisfactory for much of the planning studies available to the local communities. In view of the fact that so many of our communities, particularly those relatively large in area but small in population, are entirely devoid of base maps of any sort, the opportunity here available to them is extremely important.

Perhaps nowhere will this topographic survey be of greater value than in the location of airports. At the present time we have 71 generally agreed upon locations in the State, exclusive of landing fields and of airports used exclusively for military purposes. The precise location is a matter of the utmost importance and can be determined only by an exact and accurate knowledge of topographic conditions in the vicinity. The necessity for foresight in this connection needs no emphasis from me. We have enacted legislation relative to protecting the approaches to publicly owned airports, but there are instances where no amount of regulation can make up for a lack of knowledge.

Geologic Mapping of State

Similarly Massachusetts was the first to establish a state geological survey. It was begun in 1830 under the direction of Edward Hitchcock and continued until 1841, when it was abandoned.

A co-operative arrangement has now been established in 1938 between the Massachusetts Department of Public Works and the United States Geological Survey, Department of Interior, in a program comprising a complete geologic mapping of the State, its mineral resources, and constructional materials. It is interesting to note that one of the earliest mines in the Country was that at Sturbridge, Massachusetts, where a vein of crystalline graphite was opened about 1660 and worked during several short periods up to 1909.

It is believed that the facilities of this geologic survey could be adapted to a postwar industrial program through a study of all possible resources of industrial minerals in the State, and also that they can be used in close co-ordination with postwar plans for highway construction.

Aerial Survey of Massachusetts

Twenty years ago I wrote a report advocating the preparation of an aerial map for the City of Boston. My contention then (in 1925) was that "aerial photography, which was so effectively used for purposes of destruction during the war, has an equal opportunity to become a powerful constructive agency in the development of municipalities." Time has but strengthened me in that belief.

All of the State of Massachusetts has been flown and photographed by the United States Government in connection with and for use in the topographic survey to which reference has been made. Much of the State

had been photographed previously under various auspices, but some of these maps are now obsolete. In addition, aerial maps have been made for military purposes and may eventually become available. Many municipalities have also had aerial photographs made covering their respective areas, as well as real estate subdivisions and industrial plants, so that all in all it should be possible in normal times to assemble a complete and satisfactory collection. To mention only a few of the practical uses to which these aerial maps may be put, I would include forestry; engineering projects, such as the location of reservoirs, flood control, sewage disposal systems, power lines, highways, and railroad rights-of-way; tax assessments; mosquito control; drainage areas; recreation; and general planning and development problems.

A Soil Survey Important in Planning

A soil survey completed in the 20's should not go unnoted. A soil survey is an essential factor of a land economic survey, and, when it is properly correlated with similar data on the other natural resources, it affords a basis from which to direct the development of any given region in a more efficient manner.

It is a relatively easy matter to decide that the rich level valley lands shall be used for farming and that the steep rocky slopes shall be devoted to forestry. But there are hundreds of thousands of acres of so-called marginal and sub-marginal lands between these two extremes which require scientific knowledge for proper classification. One of the chief reasons for hundreds of abandoned farms is the fact that many of them were located on these marginal areas. Years of profitless toil, heartaches and disappointments might have been spared many of the families who fought a losing battle on those farms had the knowledge been available to them at the proper time.

The State Planning Board

You would be perfectly justified in asking me at this point what all this had to do with my work. The act establishing the State Planning Board assigns to it two specific functions:

(1) To prepare and from time to time revise and perfect a Master Plan for the physical development of the Commonwealth, and

(2) To plan and assist in planning all projects, public or private, as to which federal appropriations, grants, or loans may pay a part or all of the cost.

In further elaboration of a Master Plan, the act sets forth that it shall show the Board's recommendations with regard to the general location, character and extent of highways, bridges, waterways, flood-prevention works, parks, reservations, forests, aviation fields, drainage and sanitary

systems, agricultural areas, recreation, urbanization, trade, industry, soil conservation, water conservation, and a variety of other activities. There is not a single one of these elements of the Master Plan but what stands to be benefited by one or more of the surveys now under way.

Land Use Maps

The first step in achieving the final purpose of providing a definite basis for an orderly development of our land resources to the advantage of the Commonwealth and the local areas is to take a complete inventory of these resources and subject it to a searching analysis. With this in mind, we initiated a Land Utilization study, the results of which are shown on a series of Land Use Maps, drawn to a scale of 2 inches to the mile. These include:

(a) Maps showing existing land use and cover for individual tracts of land indicating areas devoted to various agricultural uses, types of forests and recreational uses, as well as industrial, commercial, and residential uses.

(b) Maps showing exact location of roads and buildings by their type and condition; also differences between various types of farms and part-time farms; residential, commercial, and industrial buildings; schools, hospitals, and churches; and other types of private, public, and semi-public developments, such as parks, playgrounds, golf courses, aviation fields, cemeteries, and water-supply reservoirs.

(c) Maps showing character of soil classified in several groups on the basis of productivity and adaptability for agriculture, forestry, and other uses.

(d) Maps showing the topography of each town by means of contours at 20-foot intervals.

(e) Maps indicating roads and waterways.

Water Resources Planning

The problems of flood control are closely bound up with those of soil and water conservation. Broadly speaking, there are a score or more of important river basins in the Commonwealth of Massachusetts and these we have incorporated into a series of drainage basin studies. While each river basin must be treated as an individual case, in general, the problems may be divided into six categories; i.e., water supply, sewage disposal and stream pollution, flood control, hydroelectric power, water recreation, and navigation. Studies have been completed on seven of these drainage basins and reports have been printed. The technical outline followed includes a general analysis of the watershed with a description of physical, social, and economic conditions—their present status and possibilities for future developments; a detailed study of the various elements of water use, flood control, low water control, power development, water supply—both municipal and industrial, pollution and waste disposal, irrigation, drainage, navigation, inland water recreation, and wildlife; with, of

course, special emphasis placed on the interrelationship of these various factors.

Planning for the future control of water involves many basic functions in the life of the community. We cannot plan for water unless we plan for land, for agriculture, for industry, for power, for recreation, or for many other forms of human activity. Water resources planning, therefore, must be studied not only from the viewpoint of specific problems within its own immediate technical field, but also in its relation to the problem of physical planning as a whole. This means that while our water resources studies to a certain extent stand upon their own feet, they are at the same time geared into our general program to the end that we may eventually carry out our legislative mandate "to prepare and from time to time revise and perfect a Master Plan for the physical development of the Commonwealth."

Postwar Activities

I am reluctant to end this paper without a reference to our postwar work. We realize that there is still a war to be won and that is our first consideration. Approximately 10 percent of our entire population are in uniform and we at home are making every effort to keep faith with them through the stimulation of private industry, the development of a public works program, highway and rapid transit programs, and housing and rehabilitation studies. I do not mean to say that we are doing enough; the boys at the front are rendering an unpayable service, but insofar as our efforts may prove inadequate, it will be due to human frailties rather than to neglect or lack of appreciation.

Conclusion

In conclusion, may I leave with you as indicative of my own philosophy, Washington's own words to Governor Harrison as serving most adequately to exemplify his broad grasp of the fundamentals upon which sound engineering is built. In pleading for a careful survey of the routes to the West, he urged that they be "accurately delineated, and a correct and connected map of the whole presented to the public." These things being done, he said, "I shall be mistaken if prejudice does not yield to fact, jealousy to candor, and, finally, if reason and nature, thus aided, do not dictate what is right and proper to be done." Human nature has changed but little in the intervening years, and today, I have faith to believe that maps "accurately delineated" and presented to the public in a "correct and connected" form will fulfill the prophecy of General Washington by overcoming local obstacles and opposition, and by pointing the way to that which, in the interests of our community, our state, and our Nation is "right and proper to be done."

Precision Altimetry*

By PROF. PHILIP KISSAM†

THE ANEROID barometer has a long history of usefulness for exploration, reconnaissance, and sketch mapping. It is usually considered an instrument which can give only approximate elevations, and it has never been considered as a tool for accurate mapping. With the development of the airplane, altimeters have undergone considerable improvement, both for use in the airplane itself and as an aid to the meteorologist in forecasting weather for airplane operation. With the improved instrument it should be possible to obtain more accurate elevations. If sufficient accuracy could be obtained, the possibility would exist of materially reducing the cost of vertical control for all mapping operations.

For a number of years the Wallace and Tiernan Products Company, of Belleville, New Jersey, have been building high-grade altimeters. One of their recent types was especially designed for ground surveying, and the design indicated the possibility of especially high precision. In order to discover what could be done with this instrument, this company sponsored a pilot project at Princeton University to determine what methods should be employed for barometric leveling and what accuracy could be expected in the results. The research was undertaken by the Civil Engineering Department under the direction of the author. It was not the purpose of the project to conduct an exhaustive study of the problem, but to blaze a trail for further investigation.

The results indicate that two methods of barometric leveling are entirely practical and satisfactory from a standpoint of operation, and that the results obtained are well within the limits of accuracy desirable for high-grade mapping.

The Wallace and Tiernan instruments in question have a range from minus 1,000 feet to plus 3,000 feet. The graduations are spaced at 10-foot intervals and the nearest foot can be accurately estimated. The 100-foot marks are indicated on the dial while the instrument is held at a standard pressure and the 10-foot marks are interpolated between them. The values in feet are correlated with barometric pressure in accordance with the Smithsonian Meteorological Table 51, of 1931, which is based on the density of dry air of 50° F. at sea level at latitude 45°29′. Zero elevation is set at 29.900 inches of mercury. The instruments are operated by

---

* Reprinted (in part) through the courtesy of *Photogrammetric Engineering*, January–March 1944.

† Chairman, Department of Civil Engineering, Princeton University.

metal strips rather than gears. They are jeweled and sensitive to one-foot difference in altitude. They showed no indication of friction or backlash.

Soon after tests had been begun with these instruments, it became apparent that instead of testing the instruments, it was the peculiarities of the atmosphere that were being tested.

The usual method of determining elevations by aneroids is, of course, to place an instrument at a base station (preferably at a known elevation) where readings are taken at frequent intervals. A second instrument is taken to the various field stations where elevations are to be determined. The difference between simultaneous readings of the two instruments gives the difference in altitude between two stations.

Altimeters usually are graduated in feet and, therefore, a fixed relationship must be established for any altimeter between feet of elevation and differences in barometric pressure. Actually this relationship is not fixed but changes in proportion to the change in air density. The density of the air depends chiefly upon its temperature, moisture content, and the force of gravity. Gravity in turn varies with the latitude and the elevation. Thus when accuracy is desired, corrections must be applied to the altitude differences obtained with the instruments.

It was found that in order to utilize fully the precision of the instruments, corrections for air temperature and moisture were necessary. Obviously some method had to be arranged by which these corrections could be made quickly and easily. This problem was approached in two ways, giving rise to the two methods which are recommended for precise altimetry.

The first method depends on using a single base in accordance with the usual procedure for barometric leveling. A special chart was finally developed which made it practical to apply the various corrections.

The second method utilizes two bases, preferably above and below the elevation range of the field stations. When the true difference in elevation between the base stations is known, and simultaneous indications of the instruments are read, the relationship between altitude difference and differences in elevation is known precisely at that particular moment.

The two methods were given a final field check which consisted of over 100 observations spread out over an area 20 miles square. The observations were made at stations the elevations of which had been determined by spirit-leveling. The following is a compilation of the resulting errors:

	Errors in feet	
Method	*Average error*	*Maximum error*
Single-Base	2.08	11.6
Two-Base	1.76	6.7

In the course of the research work it was found that this high accuracy could not be maintained unless certain specifications for field procedure and for computation were observed.[1]

Single-Base Method

In order to utilize a single base the air temperature had to be determined so that the proper correction could be applied. Thermometers were read at the base and at the field station and the average used. Various methods were tried to obtain the moisture content. The simplest field method proved to be the use of the wet-bulb thermometer. These values were taken at the field and the base stations and the average used.

With the usual formulas and tables it would have been impossible to determine whether or not the wet-bulb thermometers were giving the desired results, because it would have taken too long to make the necessary computations. This was accomplished, however, through the assistance rendered by Mr. Ralph M. Berry, of the United States Coast and Geodetic Survey. Mr. Berry supplied charts which he had designed for temperature corrections and a splendid set of nomographs for the computation of the effect of humidity measured by the wet- and dry-bulb thermometers.

It was found that corrections for humidity were necessary. This was to be expected as the altitude-pressure relationship of the instrument is based on dry air.

The Correction Factor Chart

Finally a chart was developed by the writer which proved practical. It can be used rapidly and provides for the corrections for temperature, humidity, altitude, and latitude.

The chart is entered with the dry- and wet-bulb temperatures as arguments. From the chart can be read a correction factor to the fourth decimal which corrects for air temperature and humidity. Since the correction for humidity varies slightly with changes in barometric pressure and the actual wet-bulb reading, a small chart was added which is entered with the average altitude and the wet-bulb reading as arguments. Since gravity varies with altitude, the correction for the change in gravity is included. It was found that an approximate average altitude and an average wet-bulb reading for a single day's work was accurate enough to be used for entering this small chart. Thus a certain value could be obtained for a day's work and applied to all the readings of the main chart. A small chart was also added to give the correction factor for the latitude. Thus to use the chart it is necessary only to add the altitude

[1] These are described in the original article.

and latitude correction factors for the day and to apply this value to any readings obtained from the main chart. The altitude difference is then multiplied by the correction factor and corrected accordingly. Two main

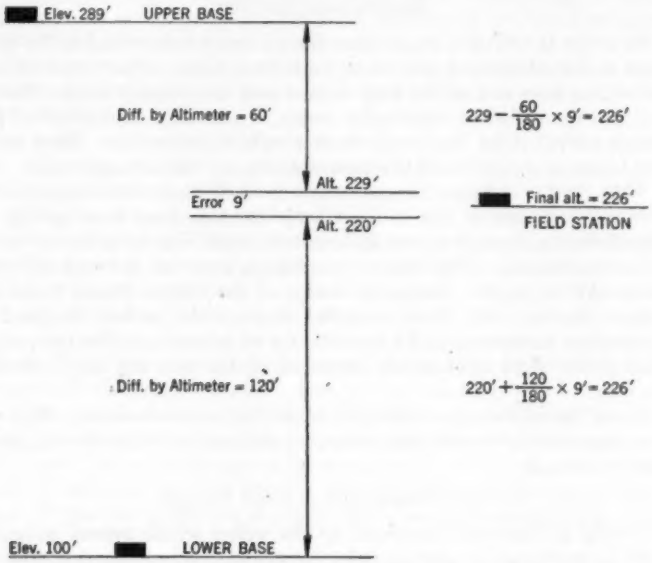

Elev. 289′ UPPER BASE
Diff. by Altimeter = 60′
229 − 60/180 × 9′ = 226′
Alt. 229′
Error 9′
Final alt. = 226′
FIELD STATION
Alt. 220′
Diff. by Altimeter = 120′
220′ + 120/180 × 9′ = 226′
Elev. 100′ LOWER BASE

FIGURE 1.—Proportional adjustment when two bases are used.

charts were prepared having zero correction at 5,000 feet and 500 feet respectively.[2]

METHOD UTILIZING TWO BASES*

When two base stations are at known elevations, the field instrument reading will give one altitude computed from the lower base and another altitude computed from the upper base. The variation between the two

[2] These charts and the co-ordinates necessary to plot them are given in the original article.

* Since publishing the article, the author has discovered that G. K. Gilbert of the U. S. Geological Survey published a report on "Experiments in Altimetry," utilizing two bases (U. S. Geological Survey Report, 1880–1891). To him should go the credit for this idea.—P.K.

altitudes is proportional between the actual air density and the density for which the instruments were calibrated. It is therefore possible to obtain the correct altitutde by adjustment in proportion to the altitude differences. This procedure eliminates all field observations and computations having to do with corrections for variations in air densities, and reduces the necessary computations to merely proportional adjustment.

In actual practice, the altitude is computed from each base without correction, and the variation between these altitudes is obtained. The variation is then multiplied by the ratio of the altitude difference to be corrected divided by the absolute sum of the altitude differences (from the two bases), and the proper altitude corrected by this amount. The same procedure can be applied to the second altitude as a check. (See fig. 1.)

* * *

Microfilm Reader-Projector

A PORTABLE microfilm reader-enlarger, weighing only 8½ pounds, has been released to industry and is now available.

In contrast to the usual library-type microfilm reading machines, this device is carried in a fitted case, like a portable typewriter. It makes possible the study at one's desk of microfilm enlargements of records, charts, blueprints, and so on, and opens up a great potential for the use of microfilm for inexpensive but effective sales presentations, engineering department drawing and specification study, employee training, and group instruction.

This reader-projector, manufactured by Federal Manufacturing Engineering Corporation, requires only 3 or 4 feet projection space and permits 24-time magnification without loss of sharpness. It is made to accommodate 35mm roll or strip microfilm. Important feature of this microfilm reader is that it can be used for short length microfilm projection. No special accessories are needed. Standard projection lamps up to 200 watts are used.—*Scientific American,* August 1944.

Property Surveys Division

EDITOR'S NOTE.—The material for this inaugural issue of the Property Surveys Division has been assembled by C. E. Hanson, Associate Editor of the Division.

FROM THE PRESIDENT

In the October 1943 issue of the BULLETIN, Professor Rayner challenged the land surveyors of the nation to organize a Technical Division within the Congress. That challenge has now been met under the leadership of S. A. Bauer, the first chairman of the Property Surveys Division. Congratulations and best wishes.

GEORGE D. WHITMORE

Officers and Committee Chairmen

Complying with the provisions of the Constitution, the following have been appointed to serve as officers and committee chairmen:

CHAIRMAN	S. A. BAUER, 1770 E. Eleventh St., Cleveland 14, Ohio
VICE CHAIRMAN	E. H. OWENS, 2715 Indiana Ave., Kansas City, Mo.
SECRETARY-TREASURER	CHARLES A. CAHN, 839 Chapel St., New Haven, Conn.
ASSOCIATE EDITOR	CECIL E. HANSON, 2638 Armstrong Ave., Los Angeles 26, Calif.
PROGRAM	PROF. G. BROOKS EARNEST, Case School of Applied Sc. Cleveland, Ohio
MEMBERSHIP	MICHAEL BAKER, JR., Baker Bldg., Rochester, Pa.
RESEARCH AND DEVELOPMENT	PROF. J. S. DODDS, Iowa State College, Ames, Iowa
TECHNICAL STANDARDS	WM. C. WATTLES, 433 S. Spring St., Los Angeles, Calif.

FROM THE OFFICERS

The importance of surveying is often overlooked in favor of more dramatic activities of science.

Its beginning, lost in the early pages of history, brought about the development of geometry and trigonometry.

Today, it forms the basis of all construction planning.

Soon, it will cover the entire nation with a network of precise control which will reflect into every community in the nation in improved surveying and mapping.

The Division of Property Surveys under the American Congress on Surveying and Mapping (the first and only national group of its kind) can contribute much to both the heritage and the future of an ancient calling.

S. A. BAUER

The profession of property-lines surveying calls for responsible trustees, who serve their clients and community with a wholehearted devotion, who can wisely discern true evidence from the false, and who must be impeccable in their experienced and knowledge-full application of the engineering and legal approach to their clients' problems.

CHARLES A. CAHN

Many centuries ago society delegated the surveyors with the trusteeship of the location of man's most cherished possession—the inheritance and ownership of land.

The time has come for the property surveyors of America to shed their cloak of isolationism and indifference; let us walk with dignity and bring respect to a truly great profession.

C. E. HANSON

It appears that the division of surveying concerned with property surveys is held in high esteem by civil engineers in general; however, there is some doubt that this opinion is shared by professional engineers in other fields, or by the layman. It is felt that the branch of surveying relating to property surveys is not sufficiently stressed in the curriculum of most engineering colleges. One worthwhile endeavor of the Property Surveys Division would be to recommend comprehensive and uniform course content for this particular portion of the course in surveying for accredited colleges.

G. BROOKS EARNEST

The calling of the property surveyor is frequently underrated by the general run of civil engineers. This is very peculiar, for the average successful engineer will show more animation in relating an early experience in a baffling land survey than in describing his achievement in building a bridge. The land surveyors can do a great deal to increase appreciation of their work by banding together and by exchanging ideas and experiences. Thus, surveyors can place their art upon the worthy footing it deserves.

J. S. DODDS

The Property Surveys Division should appeal especially to all land-surveyor members.

The objectives of the Division should be to give the much-neglected profession

of land surveying a place in the sun; to provide extensive information on procedure, practice, and ethics; to enlist and maintain co-operation for mutual benefit; and to bring to the layman, engineer, and surveyor alike the realization of the value of high-class precision in land location.

WM. C. WATTLES

AIMS AND ACTIVITIES

Tentatively the aims and activities of the Division include the following:

1. The study of existing state license surveyors laws.
2. The preparation of a bibliography on publications pertaining to surveying.
3. The correlation of present practices and needs with the teaching profession.
4. The determination of the most permanent type of monuments set for property corners throughout the nation.
5. The ferreting out of formulas, tables, graphs, equipment, survey kinks, and new practices not commonly known.
6. The study of essential legal and engineering features for the preparation of concise deed descriptions.
7. The obligation of the property surveyor under title.

Contributions on any aspect of the above program, or on anything that will enhance the status of the property surveyor, will be welcomed by the Chairman of the Division, who will distribute your ideas to the proper committee.

Remember this—"IF ONLY ORIGINAL IDEAS AND THOUGHTS WERE UTTERED—HOW SILENT WE WOULD ALL BE."

SPRING ROUNDUP

Wanted 1,000 new members before the spring thaw. All members of the Congress are urged to entice those surveyors out of the woods, stop them from grubbing around those old corner posts long enough to put their mark on the application blank.

Land surveying has been with us since Biblical times. Why wait any longer?

—C. E. H.

PROPERTY SURVEYING—THE OLDEST PROFESSION

"Ye shall therefore describe the land into seven parts, and bring the description hither to me that I may cast lots for you here before the Lord our God."

—JOSHUA 18: 6

Property Line Surveys and Land Titles

By E. H. OWENS, Registered Engineer

PREVIOUS DISCUSSIONS in the BULLETIN, of property surveying, reveal a wide lack of knowledge of—and much disagreement as to—the functions and qualifications of the property surveyor. Before real progress can be made by the Property Surveys Division, these functions and qualifications must be properly defined—both as to the present status of the profession and, more particularly, the status in the immediate future to which the Division and the practicing surveyors must adjust themselves.

The most logical approach to the subject is from the standpoint of the demands of the public upon the profession. When a property owner calls for a survey of his property, he desires and expects a finding as to the true boundary between his holdings and those of his adjoining neighbors, upon which he may rely to the extent of building improvements up to the boundary line. Also, he desires and expects to be protected and sustained in any litigation which may result from such action.

This is a large order from which the largest title insurance companies shrink. The demand, however, for such protection is becoming more and more insistent, and, strange as it may seem, this demand is being made by the large insurance companies themselves as a protection against loss on real estate loans made by these companies.

Titles and boundaries are subject to attack in—and determination by—the courts, and cannot therefore be guaranteed, but may be insured against loss. He who attempts to give an insured opinion as to a boundary must of necessity anticipate the action of the courts and must know the chain of title, not only of the property to be surveyed, but also that of the adjoining tracts. He must be informed as to all legal aspects of the matter—in fact, he is placed in the position of a commissioner detailed to investigate and decide the merits of the question and adjudicate the matter subject to review by the court. His success is measured by the percentage of cases settled without litigation. Just as a title examiner must have an abstract of title upon which to base his opinion as to the general title, so must the surveyor have that abstract and, in addition, access to all information—which may be used in an appeal to the court—relative to previous surveys, monuments, agreements, adverse possession, overlaps, and erroneous or indefinite descriptions having a bearing upon the boundary to be determined.

In addition to these qualifications, the property surveyor should be

trained in mathematics, triangulation, geodesy, determination of meridians, location and strength of National Control Systems, and in modern business.

All the foregoing qualifications avail nothing unless the person possessing them is willing to go out in the sun and wind with his information and use it in the field. The lawyer's idea of the matter is to send a transitman or even a jack staff compassman out to take a few measurements, after which the lawyer will furnish the brains. This combination must yield to the well-informed surveyor, possessing all the qualifications outlined above.

The near future will bring a combined survey and title policy—which will insure ownership up to certain described and numbered monuments, both surface and underground, supplemented by a description of the lines connecting the monuments—in lieu of the present general title policy with theoretical description which insures ownership of a more or less indefinite something, "except as to questions of survey and possession."

Will the companies issuing those combined policies be run by surveyors who employ their legal talent, or by lawyers who employ their surveyors? The fact that the present title companies run by lawyers will not guarantee the survey leaves the implication that the surveyor must organize his business in such a manner as to be able to include the general title in his survey policy. This, obviously, will mean large and financially strong survey companies covering definite territory and capable of taking care of themselves and their clients in any litigation which may occur. For this service the laws of supply and demand should provide sufficient compensation.

* * *

Method of Making Photographic Reproductions

OZALID DRYPHOTO prints to obtain fine reproductions from photographic film positives or perspective drawings.

It is claimed that this paper will capture halftone details and will bring new life-like qualities to many subjects which are uninspiring in the ordinary silver print form. The process is simple and rapid, for once a positive film is secured from a photographic negative, no baths or driers are employed in subsequent print production, no darkroom restrictions are necessary, and a hundred prints may be obtained in a few minutes. The operator feeds the ozalid positive film and a piece of Ozalid Dryphoto paper into any type of ozalid machine, which carries on, delivering the dry print in seconds. (General Aniline & Film Corp., Johnson City, N. Y.)—*Aero Digest*, November 15, 1944.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR.

"SURVEYING AND MAPPING" REACTIONS

I, or rather we, enjoy SURVEYING AND MAPPING very much. The several copies that you have sent me have been passed around to students and others. The magazine has made all of us more conscious of the real value of maps. I now call my survey courses *surveying and mapping* courses.—PROF. RALPH P. BLACK, Vice President Region 3.

. . . It would be highly desirable to adopt some insignia representative of surveying and mapping activities which could be used as part of a standard cover design. . . .

The "Current Surveying and Mapping Literature" in the Journal has brought much favorable comment and is of much value to the members here. . . .

I think it might improve the Journal if more articles were printed dealing with the practical side of map production rather than the educational side and the higher types of the work. There are more prospective members here among this class of workers than among the civil engineers. Eventually, a page might be devoted in each issue under the heading "From a Draftsman's Viewpoint." It must be realized that there are thousands of men throughout the country whose sole occupation is map drafting in some form and who have never been solicited into any organization.

. . . For the last 25 years I have nursed the idea and hope of seeing such a Journal as we now have, and after the war we must endeavor to increase our membership to the point where we will be able to make it a monthly.—HOWARD R. SAUNDERS, Vice President Region 8.

SURVEYING AND MAPPING certainly portrays the ideas and thoughts as set out at the first meeting of the Congress held in Washington, and one which I had the privilege of attending.—RALPH J. MCMAHON, Vice President Region 5.

Please accept my sincere appreciation for the splendid list of "Current Surveying and Mapping Literature" in the October 1944 issue.—PROF. PAUL P. RICE.

. . . As part of the publication is devoted definitely to "Federal Surveying and Mapping Agencies," it might be well to balance it by another part devoted

to the interest of "The Land Surveyors." It is my impression that it was the desire of the CONGRESS to reach county surveyors, private surveyors and engineers in small communities, surveyors for contractors and engineering concerns, and so on. If we do not draw such "grass-root" surveyors into the organization, our publication will only serve the same group of government surveyors that belong to other societies which meet periodically in Washington. One aim of the CONGRESS is to close the breech between the local surveyors and the federal geodesists so that they might eventually learn to understand one another. . . .

As a Technical Division on Property Surveys has been established by the CONGRESS, the allocation of a part of its publication to this phase of the surveying profession would seem timely. I presume, however, no concrete results can be obtained until suitable material reaches the EDITOR'S office from the membership of the new division.—J. G. STAACK, Chairman Division on Topographic Mapping.

. . . I have one suggestion to make: that in addition to the brief reviews of magazine articles and books under the heading "Surveying and Mapping News," there also be included perhaps a page or a page and a half for similar notes on specific current maps that are in some way distinctive or original. If this suggestion appeals to you, I should be glad to try my hand, for a while at any rate, at preparing the notes.—DR. JOHN K. WRIGHT, Chairman Division on Cartography.

EDITOR'S NOTE.—Dr. Wright's first contribution appears elsewhere in this issue under the title "Distinctive Recent Maps."

Regarding General Zubia's suggestion for a Spanish edition of SURVEYING AND MAPPING, why not include in the back of each issue a one- or two-paragraph Spanish summary of each article? This would tell any Latin American reader whether a complete translation would be worth his while.—A. F. STRIKER.

FIELD NOTES

For article dealing with similar subject, reference should be made to the October 1944 issue of SURVEYING AND MAPPING. —EDITOR.

. . . Field books may either be in bound- or in loose-leaf book form. Although the loose-leaf form has its own advantages, the writer prefers the bound book, and this for several reasons. If the pages in the book are numbered consecutively, as they should be, and the number of pages in each book is fixed, odd leaves cannot easily be detached without this being noticed. This is one preventative against any temptation to hishonest work or the removal of inconvenient pages or entries. The loose-leaf book, on the other hand, has the disadvantage that pages can easily be

slipped out and others substituted, and also, in a book handled in the field, pages with vital entries and observations in them can easily be detached accidentally or torn out and lost. The bound books are somewhat cheaper, but against this is the fact that it often happens that, as it is advisable not to allow entries relating to more than one survey to appear in a single book, every book is not completely filled and there are many pages in some of them which are never used and are therefore wasted. With the loose-leaf system, only as many pages are used as are required for the actual work in hand and the waste of paper is therefore negligible. Still, the waste of paper arising from the use of uncompleted books can be ignored when the other factors that control the choice of the form of the book are taken into account. . . . —From "The Keeping of Survey Records," *Empire Survey Review*, October 1944.

ALUMINUM-MOUNTED PLANETABLE SHEETS

COMDR. F. S. BORDEN.*—In the discussions on the relative merits of the planetable and the transit as mapping instruments,[1] one aspect of the planetable that seems to have been overlooked is the increased accuracy (and resultant speed) obtainable by the use of *aluminum-mounted* sheets.

Aluminum-mounted sheets are now standard for all planetable work in the Coast and Geodetic Survey. The decision to adopt them was based upon the results of extensive tests carried on in various parts of the country and in Alaska, and under varying operating conditions.

These tests brought out the following advantages:

1. No distortion.
2. Not subject to wind disturbance.
3. More impervious to water.
4. Details can be inked more clearly.

In one of the tests made in Alaska, the use of the finest grade cloth-mounted sheet showed a variation of from +0.30 percent to −0.82 percent over the period of use, whereas the aluminum-mounted sheet retained its original size throughout. (When it is considered that sheet distortion is one of the most bothersome aspects of planetable topography, this factor alone would have been sufficient to justify the change.) One day's field work was done in which the wind attained a velocity of 35 to 40 miles an hour in the gusts. The umbrella man was used to hold the tripod legs to keep the table from blowing away, but the sheet itself gave no trouble.

* Chief, Division of Charts, U .S. Coast and Geodetic Survey.

[1] For references to this subject, see SURVEYING AND MAPPING, July and October 1944; also this issue.

Work on a cloth-mounted sheet would have been practically impossible under like conditions.

In another test, stations were located by planetable, using aluminum-mounted sheets, and later cut in by triangulation. The maximum error in the planetable determinations was found to be 0.06 percent in distances up to 5,000 meters.

The adoption of aluminum-mounted topographic sheets by the Coast and Geodetic Survey has been followed by a notable improvement in the accuracy of positions obtained by conventional planetable methods. In addition, the sheets are, in general, preferable from considerations of convenience and ease of handling by the topographers.

* * *

"BATHYGRAM—BATHYMETER"

THOMAS H. WHITCROFT.—The Greek word *bathos*, meaning heights or depths, has long been accepted in the English language as a combining form with anatomic and oceanographic terms to denote depths, in oceanography specifically the depths of the sea. This combining form has not been used to its fullest in the United States and England, especially when applied to the instruments developed in measuring ocean depths.

In the United States, the successful sonic sounding machine of the Submarine Signal Company was trade-named the Fathometer. This name fittingly described the machine when first patented, using a contraction of fathom and the word meter, the evident meaning of the word being fathom measurer. Since that time, the fathometer has been improved to the extent that its readings are given in fathoms and feet, and the machine is not a fathometer when on the foot scale. The recording equipment accessory to the original fathometer gave a curve in fathoms over time and, naturally, could be called a fathogram. With the present-day fathometer recording in feet, the record could not be called a fathogram.

There are two words, "bathymeter" and "bathygram," which have been accepted and are descriptive for all cases. The former denotes any type machine which measures the depths of the sea, the latter denotes the automatic record from any bathymeter. By common use, the word "frigidaire" is now applied to all types of automatic iceboxes, and a similar condition will soon exist with the word "fathometer," thus causing much confusion. The use of the word "sonic" in connection with the modern sounding apparatus is also a misnomer in that supersonic sounding is used.—*U. S. Naval Institute Proceedings*, October 1944.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

THE GEOGRAPHY OF POSTWAR AIR ROUTES. *The Geographical Journal* (London), March 1944. (Includes a discussion of the value of the oblique Mercator projection for planning world routes.)

STRUCTURAL PROPERTIES OF MEDIUM- AND SMALL-SCALE MAPS. F. J. Marschner. *Annals of the Association of American Geographers*, March 1944, pages 1–46. (A comparative study of map projections, with particular reference to conformality and equal area.)

NEW CAMERA-EQUIPPED B-24'S GO TO WAR. *Aero Digest*, April 15, 1944. (Specially equipped Liberator bombers, featuring six "super-eye" cameras, are being used in reconnaissance work on both the European and Pacific fronts.)

LATITUDE AND LONGITUDE DETERMINATIONS. G. R. L. Rimington. *The Australian Surveyor*, June 1, 1944. (Describes some special methods used in establishing astronomic control for mapping the Newcastle Waters district of the Northern Territory—a country of plains and dense thickets of lancewood, with large patches of desert.)

THE KILO-YARD. O. C. Gibbins, *The Australian Surveyor*, June 1, 1944. (Describes the method used by The Hydroelectric Commission of Tasmania to co-ordinate their surveys and plans with the "Australian Grid System.")

FOR WHAT SHALL WE PLAN? H. S. McComb, *The Australian Surveyor*, June 1, 1944. (Depicts the surveyor as the keyman in city planning and suggests the inclusion of humanistic-social studies in his college education.)

MAPPING THE ROAD TO VICTORY. Frederick W. Mast, *The National Lithographer*, June 1944. (Pays tribute to the contract lithographic firms that helped meet the enormous Army requirements for the European War.)

THE LESINA PORTOLAN CHART OF THE CASPIAN SEA. E. P. Goldschmidt, *The Geographical Journal* (London), June 1944. (Describes the finding of this old map—circa 1525—in a Franciscan convent on the island of Lesina. Contains also a note by G. R. Crone on origins and identifications.)

HOW WE FIGHT WITH PHOTOGRAPHS. F. Barrows Colton, *National Geographic Magazine*, September 1944. (Describes the use of aerial photographs in spotting enemy lines and fortifications; also their application to map making, training of troops, and training of Army and Navy doctors. 22 illustrations.)

SEVENTY MILLION MAPS FOR EISENHOWER. Frank Henry, *Science Digest*, September 1944. (Describes the vast mapping program of the Army Map Service and the important role of air photography at the battle fronts.)

THE AMERICAN SOCIETY OF PHOTOGRAMMETRY: Its First Ten Years and the Next. O. S. Reading, *Photogrammetric Engineering*, September 1944.

TEN YEARS OF DEVELOPMENT IN PHOTOGRAMMETRIC EQUIPMENT AND TECHNIQUES. Robert E. Altenhofen, *Photogrammetric Engineering*, September 1944.

AERIAL CAMERAS AND PHOTOGRAMMETRIC EQUIPMENT: A QUARTER CENTURY OF PROGRESS. Revere G. Sanders, *Photogrammetric Engineering*, September 1944.

MAP ACCURACY. E. J. Schlatter, *Photogrammetric Engineering*, September 1944. (A step-by-step description of the methods used by the Soil Conservation Service in testing the accuracy of their maps produced for the war-mapping program. Describes, also, a special method for testing the accuracy of contours.)

AERIAL PHOTOS WILL BE USED IN TAKING 1945 FARM CENSUS. Gerald Dobben, *American Aviation*, September 1, 1944. (Describes method of using aerial maps.)

HYDROGRAPHIC OFFICE, UNITED STATES NAVY. G. S. Bryan, *The Military Engineer*, October 1944. (Describes the functions of the Hydrographic Office in the preparation of nautical and aeronautical charts and related publications. Includes an account of its early history.)

TRIANGULATION: BEARINGS VERSUS ANGLES. A. J. Morley, *Empire Survey Review*, October 1944.

COMPUTING A RESECTION. J. E. Jackson, *Empire Survey Review*, October 1944. (Describes the "two-diameter method" of computing the three-point problem.)

THE KEEPING OF SURVEY RECORDS. *Empire Survey Review*, October 1944. (A comprehensive discussion of the preparation and maintenance of field and office survey records, with emphasis on form, indexing, filing methods, protection of records, etc.)

THE DISCOVERY OF THE LONGITUDE. J. H. Holloway, *The Canadian Surveyor*, October 1944. (Describes the circumstances surrounding the invention of the chronometer by John Harrison. See also "The Watchmaker and the Scientist" in SURVEYING AND MAPPING, July 1944.)

A MAP IN A DAY. L. G. Trorey, *The Canadian Surveyor*, October 1944. (Describes the procedure followed by the Royal Canadian Engineers Airsurvey in preparing the 1:25,000-scale maps; includes operational instructions.)

WORLD MAPS. G. S. Bryan, *The Scientific Monthly*, October 1944. (Considers various projections from the standpoint of world mapping; concludes that a combination of three maps is the most satisfactory solution—the Mercator projection for middle latitudes and the azimuthal equidistant for the two polar regions.)

THE TERMINOLOGY OF CERTAIN MAP SYMBOLS. J. K. Wright, *Geographical Review*, October 1944. (A discussion, inviting comments from cartographers and geographers, of the tentative scheme of the American Geographical Society to establish consistent usage of terms embodying the larger categories of map symbols.)

DEVELOPMENT OF RIVER MEASUREMENT EQUIPMENT. John C. Hoyt, *Civil Engineering*, October 1944. (A brief history of the river measurement equipment used by the U. S. Geological Survey.)

THE VERTICAL STABILITY OF THE COAST AT BOSTON IN THE LIGHT OF RECENT TIDE OBSERVATIONS. H. A. Marmer, *Journal of Marine Research*, October 30, 1944.

CHARTING A WORLD AT WAR. William H. Nicholas, *National Geographic Magazine*, November 1944. (A popular and colorful description of the many activities of the U. S. Coast and Geodetic Survey and how each is geared for the war effort. Pages 617 to 640. Many illustrations.)

BOOKS

WRITING THE TECHNICAL REPORT. J. R. Nelson. *McGraw-Hill*, New York. 373 pages. $2.50. (Describes how to analyze the type of report; how to choose the best form and style; how to organize the material; and how to use figures, tables, and annotations.)

CARNEGIE INSTITUTION OF WASHINGTON YEAR BOOK NO. 42. *The Lord Baltimore Press*, Baltimore. 1943. 208 pages. (Includes numerous short summaries of the work carried out during 1942–43 in the fields of Astronomy, Terrestrial Sciences, Biological Sciences, and Historical Research in Science.)

CIVIL ENGINEERING HANDBOOK. Leonard C. Urquhart, Editor-in-chief. *McGraw-Hill*, New York. Second edition. 877 pages. 900 illustrations and tables. $5.00.

ATLAS OF GLOBAL GEOGRAPHY. Erwin Raisz. *Harper & Brothers*, New York. 1944. 64 pages. $3.50.

MODERN DRAFTING. William H. Johnson and Louis V. Newkirk. *The Macmillan Company*, New York. 1944. 197 pages. 297 plates. $2.60 postpaid.

ESSENTIALS OF AERIAL SURVEYING AND PHOTO INTERPRETATION. Talbert Abrams. *McGraw-Hill*, New York. 289 pages. 210 illustrations. $3.00. (Describes present-day methods of map making and of the operation of modern photogrammetric equipment, including a treatment of tri-metrogon mapping and the construction of relief models.)

AN INTRODUCTION TO CHARTS AND THEIR USE. M. Chriss and G. R. Hayes. *Brown, Son & Ferguson, Ltd.*, Glasgow. 88 pages. 5/– net. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

THE TECHNIQUE OF THE TERRAIN. H. A. Musham. *Reinhold Publishing*

Corp., New York. 228 pages. $3.85. (A study of maps and their use; their relation to logistics and to aerial photography.)

MAP PROJECTION STUDIES. Henry M. Leppard and L. Philip Denoyer. *Denoyer-Geppert Co.*, Chicago. 1943. 20 pages. 60 cents. (Each page depicts one or more map projections.)

THE WAR IN MAPS. Francis Brown. *Oxford University Press.* Third revised edition. 1944. 167 pages. $2.00.

DISTINCTIVE RECENT MAPS

EDITOR'S NOTE.—SURVEYING AND MAPPING is grateful to Dr. Wright for volunteering to contribute regularly information on recent map contributions.

The Army Map Service has reproduced and distributed to certain libraries and universities a series of colored maps entitled "Climatic Zones." These were compiled by the Climatology Unit, Research and Development Branch of the Office of the Quartermaster General. For each continent and for the United States there are 12 maps showing the climate month by month, and for the oceans there are four seasonal world maps. A consistent scheme of colors and patterns is employed throughout, whereby 8 categories of climate are differentiated according to temperature and 3 according to precipitation.

Africa west of the Greenwich meridian is covered by the new (1943) *Sheet 42, West Africa* of the useful map of *Asia and Europe*, 1:4,000,000, of the Geographical Section of the British General Staff. This map, which conforms in layout, lettering, and general appearance to the International Millionth Map, has also been reproduced by the Army Map Service.

Two series of large poster-style maps are being currently issued for the information and training of the men in the armed services. They illustrate the course of the war and its larger strategic problems. The main map of each issue of the weekly *Newsmap for the Armed Forces*, prepared and issued by the Army Information Branch, Army Service Forces, shows a theater of war currently in the news and has frequently been in the form of a striking photographic reproduction of a relief map model on which names, routes, etc., are overprinted. On the back of the main map are printed smaller maps and text. *Nav War Map*, issued by the Education Services Section, Bureau of Naval Personnel, is a comparable series of brilliantly colored diagrammatic maps illustrating current naval events (No. 1, The Mediterranean; 2, The South China Sea Area; 3, World War 2 in the North Sea Area; 4, The North Pacific Area).

Professor A. K. Lobeck of Columbia University has recently prepared a new "Physiographic Diagram of Europe," on which landforms are shown in black and white in exquisite detail. The diagram (really a map) is issued in three scales, 1:1,000,000 (in 9 sheets), 1:2,000,000 (in 2 sheets), and 1:3,000,000 (in 1 sheet), and is published by The Geographical Press, Columbia University, New York, 1944.

Twenty-one types-of-farming areas in England and 17 in Scotland are differentiated by colors and patterns on a two-sheet map entitled "Great Britain: Types of Farming," 1:625,000, published in 1944 by the Ordnance Survey. This is a companion to a Land Utilization map on the same scale published by the Ordnance Survey in 1942.

The U. S. Coast and Geodetic Survey has issued a map of "Lines of Equal Magnetic Declination and of Equal Annual Change in Alaska for 1940," 1:5,000,000, embracing not only Alaska but the neighboring parts of Canada and Siberia.

The Instituto Geografico Militar y Catastral of the Republic of Colombia is issuing a series of topographic maps of the municipios (counties) of Colombia (with town plans as insets). Of this series the American Geographical Society has received 11 maps on the scale of 1:50,000 and 23 on the scale of 1:25,000, of which the great majority are of municipios in the State of Cundinamarca.

JOHN K. WRIGHT

BOOKS RECEIVED

AERIAL PHOTOGRAPHS: Their Use and Interpretation. A. J. Eardley. *Harper & Brothers*, New York. 1942. 203 pages. 46 plates. 46 figures. $2.75. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

FOREIGN MAPS. Everett C. Olson and Agnes Whitmarsh. *Harper & Brothers*, New York. 1944. 237 pages. 16 plates in color. 25 figures. $4.00. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

T T T

New Map Making Idea Wins Award

WILLIAM T. RYALL, a civil engineer with the U. S. Engineers in the Little Rock, Arkansas, District, recently received the Exceptional Civilian Service award—the highest civilian honor awarded by the War Department—for developing a device which is said to greatly improve existing methods of mapping large areas and difficult terrain.

Engineers say that Mr. Ryall's invention has revolutionized the establishment of secondary controls for mapping and surveying of highly specialized projects and has cut the cost in money, manpower, and time, while practically eliminating the margin of human error.

Through the use of small helium gas balloons and short wave radio communications, a crew of 20 men can survey as great an area in a day as that formerly surveyed by 50 men.—*Engineering News-Record*, July 6, 1944.

Distances and Directions from New York

AT THE REQUEST of the Port of New York Authority, the American Geographical Society has prepared a 1:35,000,000-scale map on the azimuthal equidistant projection centered on New York. The map sheet is about 18 by 20 inches and is printed in black with a buff tint over the land areas. It embraces the whole of the United States, Central and South America, most of Canada, Greenland, and Europe, and the whole of the west coastline of Africa. Some place names are shown—selected to a large extent on the basis of their importance in international air travel. The map includes a marginal protractor and a scale of statute miles for measuring directions and distances from New York.—*Geographical Review*, July 1944.

* * *

Photographic Process of Template Production

Called the Photoprint Process the method produces undistorted full-scale line reproductions of templates, mold loft layouts, and drawings on sheets of any desired rigid material such as metal or on paper or linen for blueprinting.

Reproduction is obtained through direct contact of the original drawing with the sensitized surface to which the drawing is to be transferred. A negative plate is prepared by bonding a sheet of sensitized paper to a glass plate with an adhesive.

A template drawing is then brought into contact with the sensitized paper in a specially designed jig. Yellow light, passing through the glass, and through the paper, strikes the drawing and is reflected back to the sensitized paper, thus exposing it.

Since the drawing and the sensitized paper are in close, precise contact, an exact transfer to the sensitized paper occurs. The exposed plate is then developed to produce a reverse copy of the original—white lines on a black field. This negative may then be used to make any desired number of positive prints on the template metal.

A light sensitive emulsion is applied to the metal and the exposed, emulsion side of the negative plate is placed and held, in firm contact with the emulsion side of the metal. The template is then developed, whereupon an exact reproduction of the original drawing is obtained upon it.

To complete the cycle of template production, and repeat the process, the exposed negative paper is removed from the glass plate, and a new sheet of sensitized paper applied. To prevent blistering the paper when

immersed in the developing solution, a tenacious adhesive, highly resistant to moisture and chemicals is employed to bond it to the glass plate.

When several plates have completed the production cycle, they are immersed in a *Turco Prosolv* solution for ½ hour and the loosened paper removed, the glass rinsed and dried, and prepared to receive a new coating of sensitized paper. (Turco Products, Inc., 6135 S. Central Ave., Los Angeles 1, California.)—*Aero Digest*, September 1, 1944.

New Map of Southeast Asia

A TIMELY ADDITION to the National Geographic Society's wartime series of map supplements is the new Map of Southeast Asia and Pacific Islands. The new chart, together with its companion Map of Japan (April 1944), portrays in detail the heart of the vast Pacific battleground. They are drawn on the largest scale ever used by the Society in mapping this area.

Key cities and strategic islands are charted in 22 large-scale insets. Among them are Shanghai, Hong Kong, Singapore, Manila, Saipan, Guam, and Rota.

The new map is constructed on the transverse Mercator projection, at a scale of 126 miles to the inch. It is printed in 10 colors, on a sheet 41 by 26½ inches.—*National Geographic Magazine*, October 1944.

Maps on Microfilm

Summary.—Results of research on the reproduction of maps in 35-mm color and black-and-white film are described. This research involved a thorough study of the effect of material, equipment, and processing on resolution. Observations of these effects have been carefully studied and the results are presented with a discussion of some of the factors influencing them.

The conclusions drawn from this research are: (1) The reproduction of colored maps in color on 35-mm film is impossible because of the low resolving power of present color emulsions. (2) Reproduction of colored maps in monochrome on 35-mm is not satisfactory because of grain clumping in magnification above 20 ×. (3) The resolution of an image is a composite function depending on the degree of correction in the optical system producing it, the resolving power of the material reproducing it, and the processing it undergoes.—Michael Bruno in *Journal of the Society of Motion Picture Engineers*, November 1943.

Book Review

HYDROGRAPHIC MANUAL (U. S. Coast and Geodetic Survey). Commander K. T. Adams. *U. S. Government Printing Office,* Washington, D. C. 940 pages. $2.75.

Reviewed by F. H. Peters, Surveyor General and Chief,
Hydrographic Service, Canada.

THROUGH the courtesy of the U. S. Coast and Geodetic Survey we have received the above book with an invitation from the Editor of the American Congress on Surveying and Mapping to review it. In the present instance, the reviewer of a hydrographic manual will be forgiven for comment on the lines of the reader of a dictionary who found it full of interest but weak in plot. This is not an easy book to read, and to comment on the great variety of subjects is out of the question. It is essentially a volume of instructions designed to meet the particular requirements of the U. S. Coast and Geodetic Survey in the execution of hydrographic surveys and, as such, the emphasis is on standardization of methods, and a considerable part of the book deals with detailed descriptions of instruments and equipment used. When one considers the diverse and widespread operations of so complex an organization as the U. S. Coast and Geodetic Survey, the need of rigid uniformity in all phases of the work is at once apparent. The instructions set a very high standard for field and cartographic work. Chart makers are fortunate in having so many subjects brought together for them between the covers of one book.

The Manual, though a practical reference volume, is definitely not intended to replace the standard textbooks on hydrography—indeed one of the most valuable features of the book is the exhaustive references to more detailed information on many of the subjects under discussion. In hydrographic work, as in any other profession, set rules are no substitute for experience, though a book of instructions might seem to provide the answers to almost every conceivable circumstance that might arise. But for the purposes for which this Manual is intended, it will satisfy the needs of experienced hydrographers as well as the novice: however skilled one may be he will find plenty of useful information in this compendium of hydrographic data.

Included in the Manual are detailed discussions of such subjects as "Control and Signal Building," "Hydrography," "Equipment and Instruments," "Echo Sounding," "Radio Acoustic Ranging," "The Smooth Sheet," and "Records and Reports."

In a volume so immense and dealing with so many subjects, its maximum usefulness is dependent on an adequate index and, in consequence, an elaborate dual index system has been provided. The material in the book is arranged in card-index fashion which will facilitate keeping the work up to date in accordance with future developments in hydrography. What these developments will be no one is given to know, but if the experience of the past is to be taken as an index of the future, the science of hydrography will continue to expand. In spite of the War—in fact, because of the War—new methods of ship-location and air photography may be developed, and cumbrous apparatus may be supplanted by less unwieldy and more efficient instruments.

A discussion on sizes of printed charts would have been of value. The determination of suitable chart scales and the selection of chart limits are matters of greatest importance that can be decided only after complete consideration of all the navigational factors involved. Nautical charts beyond a certain size, approximately 30 by 40 inches, are unwieldy and except on very large vessels where ample chart table space is available, large sheets are extremely awkward to use. Too frequently large scale is retained by sacrificing convenience of chart size, when the same sea area might more reasonably have been covered by a somewhat smaller-scale chart of more practical dimensions. But because the authors of a manual omit what one person has always considered a most important phase of marine cartography is no reflection on the book.

Books on the subject of hydrography are comparatively rare and this new contribution on the subject is very welcome. The text is illustrated by a series of well-chosen photographs and clear-cut diagrams. It is excellently produced and the United States Coast and Geodetic Survey is to be congratulated on adding this solid work to its series of notable publications.

EDITOR'S NOTE.—Mr. Peters' reference to chart sizes and scales was called to the attention of Commander Adams who furnished the following comment:

The Hydrographic Manual is essentially a field manual and deals principally with field work. In the Coast and Geodetic Survey hydrographic *surveying* is considered to end with the completion of the smooth sheet and does not include the office phases of compilation and reproduction of nautical charts. Field personnel do not decide chart limits. Neither do project limits nor smooth sheet limits ordinarily coincide with chart limits. I, personally, fully agree with Mr. Peters' contention that unnecessarily large nautical charts are unwieldy and awkward to use on smaller vessels.

CONGRESS NEWS

Reports of Technical Divisions

Surveying and Photogrammetric Instruments

". . . It is the desire and intention of the Division to interest in its activities those who design and manufacture instruments, as well as all engineers, surveyors, and photogrammetrists—especially those in Government service, in the colleges and technical schools, and in private surveying and mapping practice—who by their training and experience have expert knowledge of instrumental requirements. It is believed that considerable benefit should result from a general exchange of views among groups indicated, and that perhaps there would develop a desire for an annual or periodic exhibit of the products of the different makers."

H. M. DIBERT, *Chairman.*

Control Surveys

" . . . With all the control surveys and mapping carried on in cooperation with the military authorities for the last 3 years by various federal bureaus, there is a wealth of material suitable for consideration at the first time it is possible to arrange a meeting."

C. L. GARNER, *Chairman.*

Topographic Mapping

" . . . I have no concrete plans in mind as to the future activities of the Division. We are all hoping that this war will end successfully and soon so that our attention may be directed to domestic matters and postwar programs. It is conceivable that much surveying and mapping will be activated in the postwar period and that the work of this Division will be stimulated by many of our members who, now in military and naval services, will have many worthwhile experiences and new ideas to contribute."

JOHN G. STAACK, *Chairman.*

NEW MEMBERS

BEAIRD, O. PRESLEY
Field Engineer, Los Angeles Co. Flood Control District, Los Angeles, Calif.

BELTON, RICHARD J.
Topographic Engineer,
U. S. Geological Surv., Wash., D. C.

BERKE, JACOB H.
Surv., Bonded Surveyors of America,
740 N. Plankinton, Milwaukee, Wis.

BRUCE, FRED H.
Ch. Engr., J. S. Abercrombie Oil Co.,
Gulf Building, Houston, Texas

CHILSON, J. WALTER
Civil Engineer,
33 Fales Street, Franklin, Mass.

DICKEY, CRAWFORD
Associate Topographic Engineer,
U. S. Geological Surv., Wash., D. C.

DOUGALL, MATTHEW
Asst. Ch. Draftsman, Los Angeles Co.
Flood Control District, Los Angeles

EDMONSTON, HAROLD R.
Asst. Ch., Surveys Br., U. S. Coast
& Geodetic Surv., Washington, D. C.

EDWARDS, ROBERT J.
Assoc. Dir., Cleveland Reg. Geod.
Surv., Richmond Rd., Bedford, Ohio

FISHER, CHARLES R.
Topographic Engineer,
U. S. Geological Surv., Rolla, Mo.

FREEMAN, JOSEPH H.
Ch. Draftsman, Los Angeles County
Flood Contr. District, Los Angeles

GIBBINS, OLAF C.
Engineering Surv., The Hydroelect.
Comm., Hobart, Tasmania, Australia

GREENEWALD, GEORGE A., JR.
Manager, Surveyors Service Company,
512 S. Broadway, Los Angeles, Cal.

KENNISON, LARRY M.
Civ. Engr., Soil Conservation Serv.,
1103 16th St., S., Arlington, Va.

KIDD, ROSS R.
Land Surv., Skinner & Compton, Engrs.
and Land Survs., Penns Grove, N. J.

KING, JASPER E.
Project Engr., U. S. Forest Service,
Box 56, Gettysburg, Pennsylvania

LYON, PIERSON C.
Assistant Topographic Engineer,
U. S. Geological Surv., Rolla, Mo.

MACILQUHAM, W. L.
Surveys Engineer,
41 Grove Avenue, Ottawa, Canada

MORAN, EDWARD A., JR.
Constr. Engr., City of Jersey City,
17 Magnolia Ave., Jersey City, N. J.

MURRAY, HAROLD W.
Cartographic Engineer, U. S. Coast
& Geodetic Survey, Washington, D. C.

OGLE, ALEXANDER J.
Topographic Engineer,
U. S. Geological Surv., Wash., D. C.

OROZCO, ISIDRO G.
Chief Engineer, Comision Nacional
de Irrigacion, Mexico, D. F.

PAQUENTIN, EDUARDO
Ing. Topografoe Hidrografo,
Avenida Amores 1037, Mexico, D. F.

SAWCHUK, HENRY A.
Ensign, Shore Estab. and Personnel
Div., Navy Dept., Washington, D. C.

SCHOPFER, WILLIAM C.
Topographic Engineer, U. S. Forest
Service, Box 56, Gettysburg, Penn.

SIMMONS, HENRY E.
Topographic Engineer,
U. S. Geological Surv., Wash., D. C.

SMITH, ROBERT H.
Cartog. Engr., Aero Service Corp.,
133 W. Wharton Rd., Glenside, Pa.

SMITH, RONALD N.
Asst. Engineer, The Hydroelectric
Comm., Hobart, Tasmania, Australia

STEWART, WILLIAM E.
Topographer, Cleveland Reg. Geod.
Surv., 11216 Fairhill, Cleveland, O.

THOMAS, PAUL DELOREN
RT/3c, U. S. Navy,
2935 W. Polk Street, Chicago, Ill.

TRUMPY, JAY WALTER
Topographer, State Highway Dept.,
13008 Brackland Ave., Cleveland, O.

TUBMAN, HENRY H.
Capt., Exec. Off. 650th Eng. Topog.
Bn., APO 322–1, c/o P. M., San Fran.

ULLIAN, H. B.
Civil Engineer,
73 Tremont Street, Boston, Mass.

VAUGHAN, EDWARD
Right-of-way Engr., Los Angeles Co.
Flood Contr. District, Los Angeles

WARD, VICTOR A.
Jr. Engineer, Magnolia Petroleum
Company, Box 900, Dallas 1, Texas

WATTS, RICHARD G.
Asst. Ch. Engr., Magnolia Petroleum
Company, Box 900, Dallas 1, Texas

WEISHAPPLE, CHARLES E.
Assistant Topographic Engineer,
U. S. Geological Surv., Rolla, Mo.

WRATHER, WILLIAM E.
Director, U. S. Geological Surv.,
Dept. of Interior, Wash. 25, D. C.

LIBRARY MEMBERSHIP

LIBRARY OF THE HYDROELECTRIC COMMISSION
Hobart, Tasmania, Australia

Land Surveyors Conference

On October 21, 1944, the New Jersey Society of Professional Engineers sponsored the Sixth Annual Land Surveyors Conference at Rutgers University. Among the papers presented was one by Professor Douglas S. Trowbridge, Vice President of Region 1, on "The American Congress on Surveying and Mapping." The discussion was led by Professor F. C. Mirgain of Rutgers. The co-operation between the New Jersey Society and the Congress in the exchange of publications was mentioned, and everyone felt that this exchange should continue.

* * *

"For of Meridians, and Parallels,
Man hath weav'd out a net, and this net throwne
Upon the heavens, and now they are his owne.
Loth to goe up the hill, or labour thus
To go to heaven, we make heaven come to us."
—JOHN DONNE, 1611.

COMMERCIAL INSTITUTIONAL MEMBERSHIPS

•

ABRAMS INDUSTRIES, Lansing, Mich. { ABRAMS AERIAL SURVEY CORP. / ABRAMS INSTRUMENT CO. / ABRAMS AIRCRAFT CORP.

AERO SERVICE CORPORATION
236 East Courtland St., Philadelphia, Penna.

THE BAKER ENGINEERS
Consulting Civil Engineers & Surveyors
Baker Bldg., Rochester, Penna.

C. L. BERGER & SONS, Inc.
Precision Surveying & Astronomic Instruments
37 Williams St., Boston, Mass.

W. & L. E. GURLEY
Engineering & Surveying Instruments
Troy, New York
(4 Memberships)

KEUFFEL & ESSER COMPANY
Drawing Materials & Surveying Instruments
Adams & Third Sts., Hoboken, N. J.

RAND McNALLY & COMPANY
Map Engravers and Publishers
Chicago, Illinois
(4 Memberships)

Membership in the American Congress on Surveying and Mapping

THE AMERICAN CONGRESS ON SURVEYING AND MAPPING is a non-profit organization whose objectives shall be: "To advance the sciences of surveying and mapping in their several branches, in furtherance of the public welfare and in the interests of both those who use maps and surveys and those who make them, and to establish a central source of reference and union for its members; to contribute to public education in the use of maps and to encourage the prosecution of basic mapping programs which are paid in whole or in part with public funds."

Any person interested or engaged in surveying and mapping whose application has been approved by the Committee on Admissions may become a member of the CONGRESS.

AMERICAN CONGRESS ON SURVEYING AND MAPPING

Box 470, Benjamin Franklin Station, Washington 4, D. C.

I hereby apply for membership in the AMERICAN CONGRESS ON SURVEYING AND MAPPING and agree to be governed by the Constitution, Bylaws, and Rules of the Congress while holding membership.

..... (Date) ..... (Signature)

Name .....
(With desired title of address)

Address .....

Occupation (with title) .....

Please give two references (not necessarily members of the Congress):

(1) ..... (Name) ..... (Address)

(2) ..... (Name) ..... (Address)

Annual dues of $4.00, of which $3.00 is set aside for the publication of SURVEYING AND MAPPING, are payable on notification of acceptance and entitle members to all privileges of the Congress and to all its publications.

ORGANIZATION OF THE CONGRESS

Committee Chairmen

EXECUTIVE	GEORGE D. WHITMORE
PUBLICATIONS	COMDR. FRANK S. BORDEN
ADMISSIONS	LT. COMDR. PAUL A. SMITH
ANNUAL MEETING	MURRAY Y. POLING

Technical Divisions Chairmen

CARTOGRAPHY	DR. JOHN K. WRIGHT Broadway at 156th Street New York, N. Y.
CONTROL SURVEYS	CAPT. C. L. GARNER Coast and Geodetic Survey Washington, D. C.
PHOTOGRAMMETRIC MAPPING	VIRGIL KAUFFMAN 236 East Courtland Street Philadelphia, Pennsylvania
PROPERTY SURVEYS	S. A. BAUER 1770 East Eleventh Street Cleveland, Ohio
SURVEYING AND PHOTOGRAMMETRIC INSTRUMENTS	H. M. DIBERT 514 Fulton Street Troy, New York
TOPOGRAPHIC MAPPING	JOHN G. STAACK U. S. Geological Survey Washington, D. C.

Past Presidents

ROBERT H. RANDALL PROF. J. S. DODDS